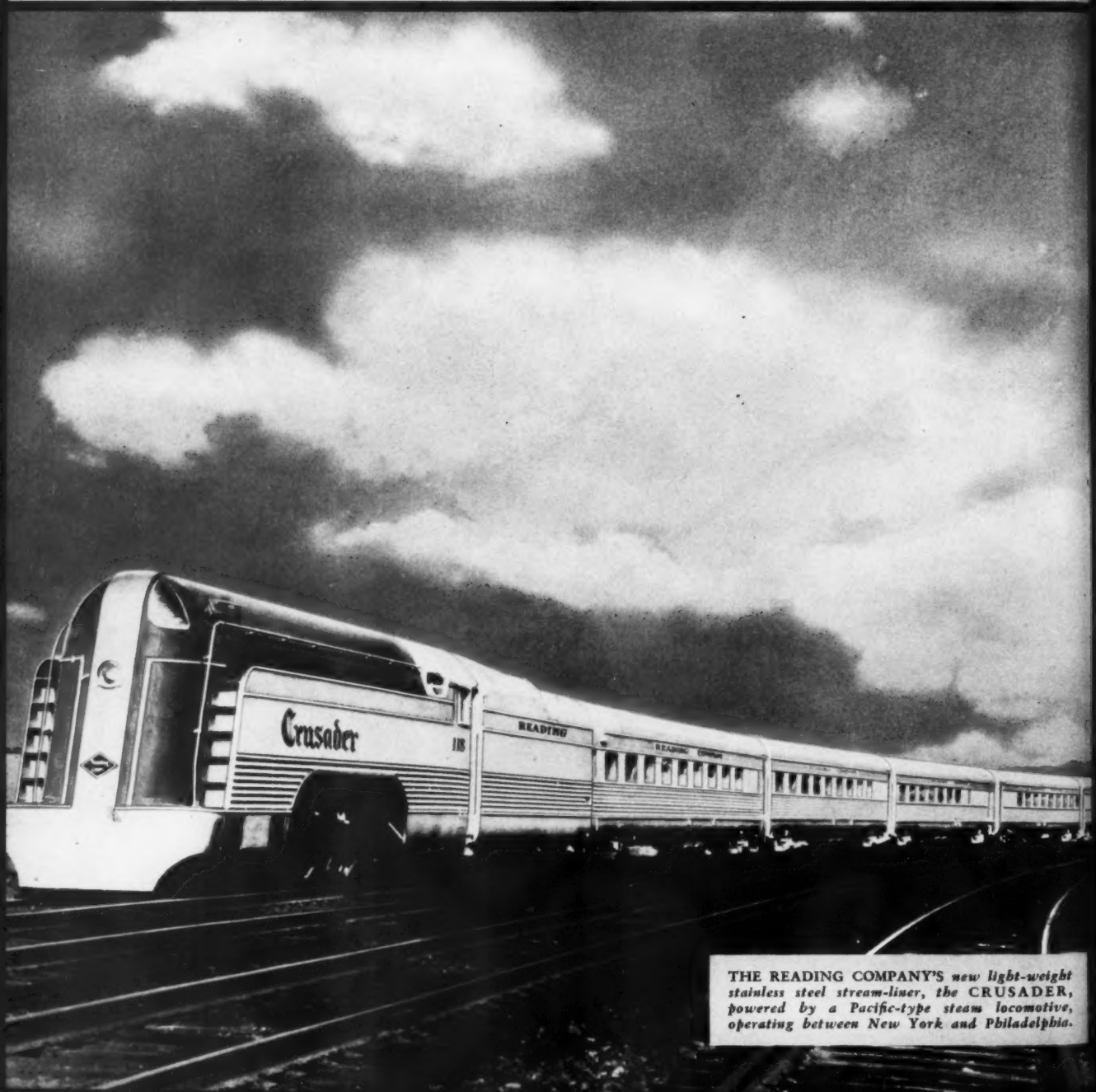
JOINTS FOR EVERY PURPOSE
Based on 50 Years Experience

Reliance HY-CROME Spring Washers

HY-PRESSURE HY-CROME
"Edgemark of Quality"

Railroads have never knowingly compromised with safety in their purchases of parts and materials for maintaining proper track joint conditions. The advent of HY-CROME *Spring Washers* introduced an increased factor of safety that was justified chiefly by reducing maintenance periods and by prolonging rail life. Today the majority of the safest, fastest main line tracks of the country are equipped with HY-CROME protection — a safe-guard of profits as well as of track materials. HY-PRESSURE HY-CROME — with its superior reactive values and carefully calibrated pressures — adequately meets varying track joint conditions in every application. Our Sales Engineers will be glad to discuss this and other types of HY-CROME track washers with you.

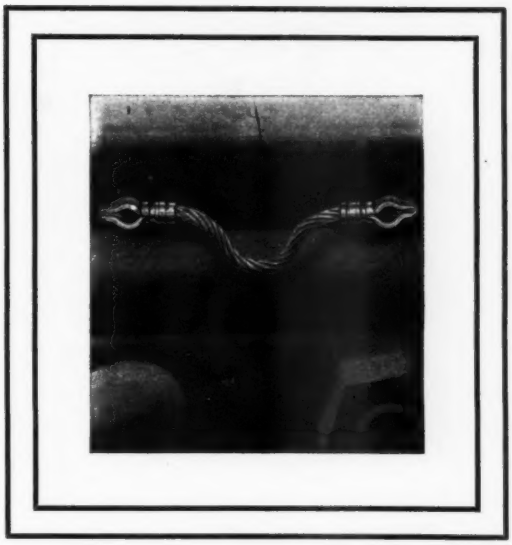
EATON MANUFACTURING COMPANY
RELIANCE SPRING WASHER DIVISION
MASSILLON, OHIO



THE READING COMPANY'S *new light-weight stainless steel stream-liner, the* CRUSADER, *powered by a Pacific-type steam locomotive, operating between New York and Philadelphia.*

RACO BONDS

improve railway service



(Patent Nos. 1,945,980 and 2,045,126)

They have reduced the number of train interruptions.

They have increased broken rail protection.

They have improved track circuit operation.

They have effected very substantial economies.

During the past six years over 1,500,000 Raco Bonds have been installed on 38 railroads.

RAILROAD ACCESSORIES CORPORATION

MAIN OFFICE

405 LEXINGTON AVENUE

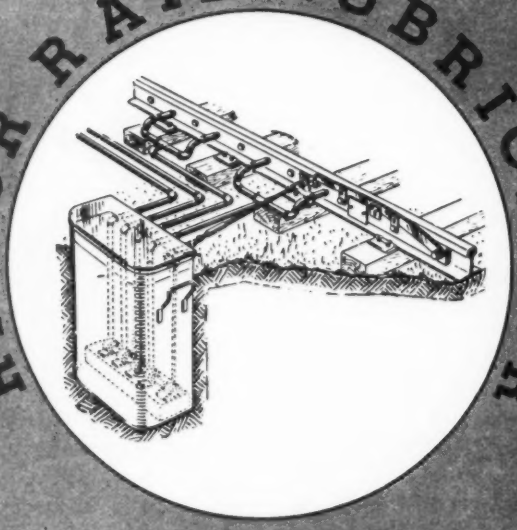
(Chrysler Building)

NEW YORK

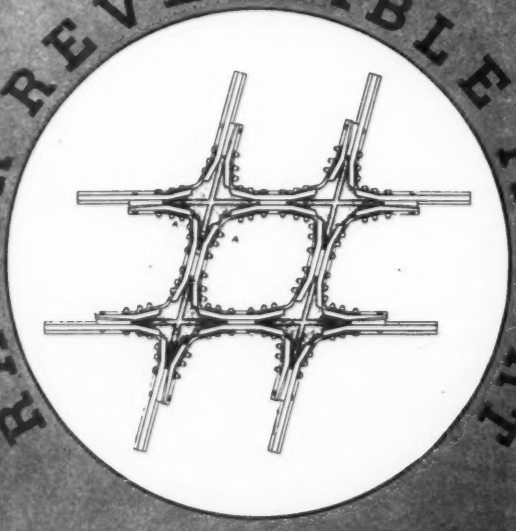
Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, and Canada, $2.00; Foreign $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

RACOR REDUCES REPLACEMENTS

RACOR RAIL LUBRICATOR



RACOR REVERSIBLE INSERT



RACOR Specialties save money in two ways. First, they can be relied upon for long service, thereby reducing replacement costs. Second, they are so well designed and soundly built that maintenance is reduced to a minimum.

RACOR

Take the Rail Lubricator for example; substantial operating parts and flexible connections require but periodic inspection. It is only necessary to keep the reservoir filled and the few exposed parts oiled. Extensive tests over a long period prove that the money saved on rail and wheel purchases pays for the lubricator in a comparatively short time. It is a real investment.

With the Reversible Insert Crossings, maximum service life is obtained through the use of surface hardened Manganese Steel. Maximum economy comes from a design whereby inserts can be shifted as they wear, just as tires are changed on a car. This crossing is especially recommended for locations where traffic is heaviest.

RAMAPO AJAX

Division of

The American Brake Shoe and Foundry Company

CANADIAN RAMAPO IRON WORKS, LIMITED

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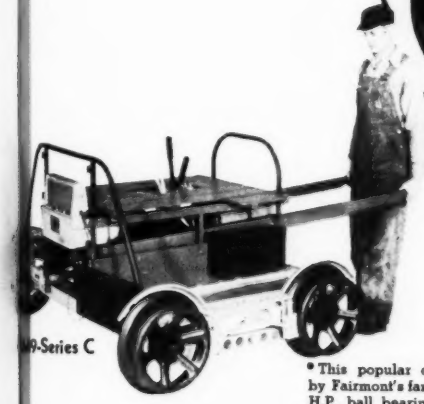
Men who ride ALONE *need the* SAFETY *of*

Fairmont

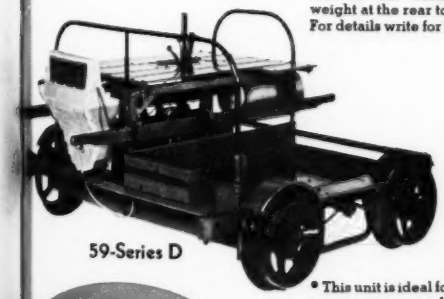
M9-Series D

• This spring-mounted car is powered by Fairmont's 5 to 8 H.P. RO roller bearing engine and embodies many advanced features making for economical operation and maintenance. It's the lightest inspection car in its class. Lift weight at the rear is only 95 lbs. For easy access to the engine, the oak seat top can be quickly removed by unloosening 4 latches. Ask for bulletin 391.



9-Series C

• This popular car is powered by Fairmont's famous OD 5 to 8 H.P. ball bearing engine. The use of aluminum parts throughout the car reduces the lift weight at the rear to only 95 lbs. For details write for bulletin 404.



59-Series D

• This unit is ideal for the emergency runs of linemen and signal maintainers. Its extra-wide tray holds all of the battery renewals, drills and other supplies needed on any trip. Bulletin 389 gives complete facts.

• Road masters, signalmen and others who work alone, or in pairs, like the extra protection provided by the advanced safety features of Fairmont one-to-two men inspection cars. Equipped with 4-wheel brakes, these modern cars can be stopped quickly in emergencies. Lift handles, extending either front or rear, reduce the weight to the minimum and assure quick removal and easy rerailing of the car by one man. Powered by Fairmont 5 to 8 H.P. ball bearing or roller bearing engines, Fairmont inspection cars make good time under severe operating conditions and serve at lowest cost. Write for complete facts. Fairmont Railway Motors, Inc., Fairmont, Minnesota.

erformance
N THE JOB
COUNTS

OF ALL THE CARS IN SERVICE TODAY
MORE THAN HALF ARE FAIRMONTS

MECO MAKES A STRANGER OF A CURVE FRICTION!

"TRUTH IS STRANGER THAN FICTION"
and it's the truth that

MECO LUBRICATORS

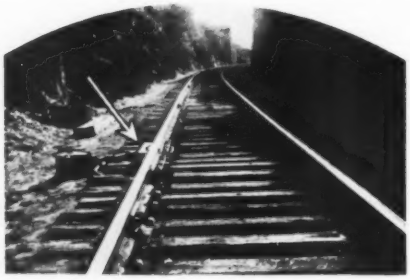
take the teeth right out of curve friction and reduce curve resistance to practically that of tangent track.

CUT COSTS SIX WAYS

- Reduce cost of maintaining gauge and line on curves.
- Decrease replacement cost by prolonging curve-rail life.
- Eliminate wheel screeching on curves.
- Decrease train resistance—cut fuel costs.
- Increase safety of train operation and permit higher speeds.
- Where curve resistance is governing factor, often eliminate helper service or permit higher tonnage ratings.

ECONOMICAL LUBRICATION

A single Meco protects a number of curves. The total lubricating costs per thousand wheel flanges and per curve mile are surprisingly low. Approved graphite paste lubricants function satisfactorily the year 'round.



More than 95 railroads use our Lubricators and over 3300 are in service.

Pioneers in the development of curve lubrication.

MAINTENANCE EQUIPMENT CO.

RAILWAY EXCHANGE, CHICAGO, ILLINOIS

HOW TO CUT RAILROAD MAINTENANCE COSTS . .

Eliminate expensive rolling stock by using the mobile, low-cost FASTER POWER of Allis-Chalmers tractors. One man and one tractor will handle such varied jobs as ditching along right-of-ways, grading for new lines and sidings, cleaning culverts and under bridges and trestles, laying and dismantling track, spreading and levelling ballast, operating compressors and welding generators, cleaning up around yards, clearing slides, loading and unloading materials and supplies, etc. A-C tractors work off the tracks. No interference with freight or passenger trains. No big crews kept idle while switching to clear tracks. No time lost getting up steam—A-C tractors start instantly and go right to work. With them you have plenty of reserve power for quick grade climbing in rough country and for moving heavy loads; plus FASTER POWER to gain time hauling . . . and returning . . . and for easy handling in narrow quarters.

Model K Tractor and Baker bulldozer working in the yards of the Pennsylvania R.R., Harrisburg, Penn. When not bulldozing tractor drawbar is free for pulling purposes—hauling compressors, switching, etc.

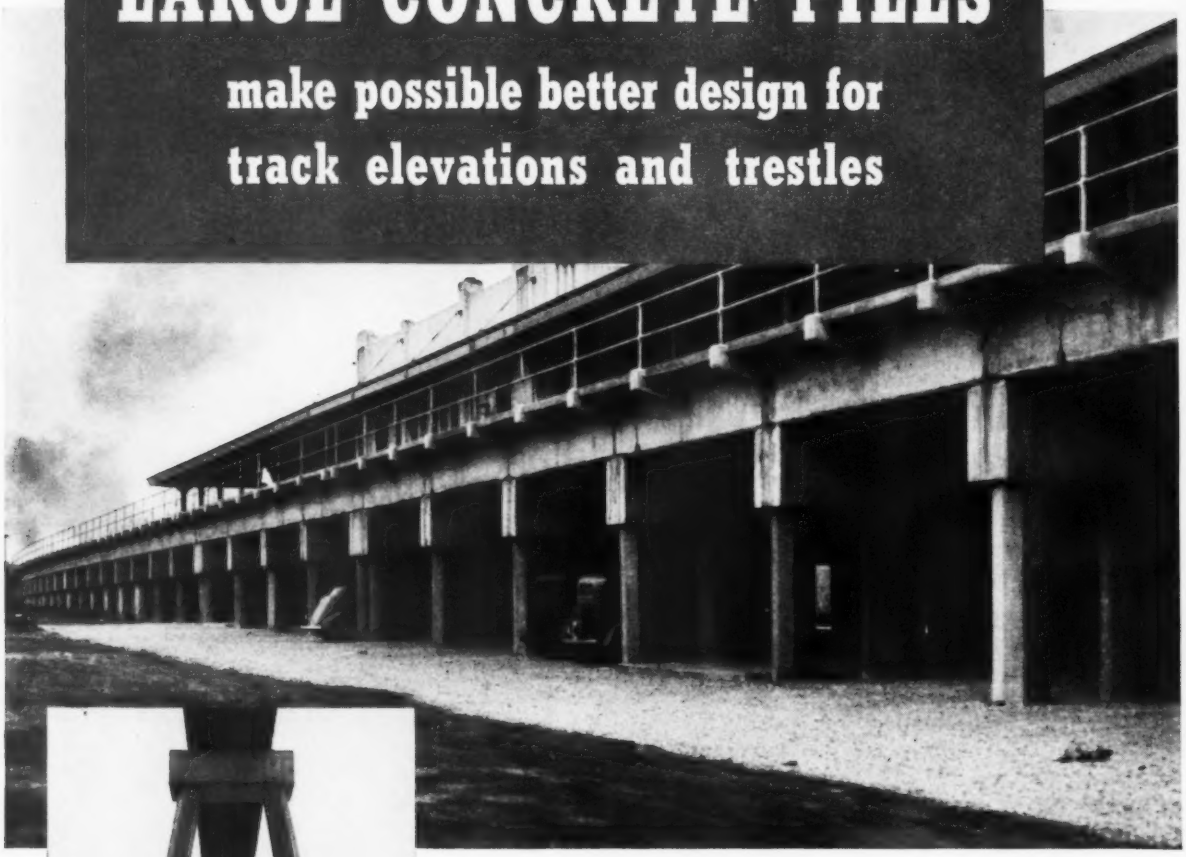
ASK YOUR NEAREST ALLIS-CHALMERS DEALER TO SHOW YOU HOW A-C EQUIPMENT CAN CUT YOUR MAINTENANCE COSTS.

ALLIS-CHALMERS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

LARGE CONCRETE PILES

make possible better design for track elevations and trestles



52 high towers incorporating 24-in. octagonal concrete piles—part of Missouri Pacific bridge over White River in Arkansas. This design provided an economical structure which could be installed without altering the existing pile trestle. 31 towers were precast and lifted into place and 21 were cast in place, all without interfering with traffic.

●

(*above*) L & N track elevation at Louisville, Ky., now in use, includes 1500 24-in. octagonal piles in 6300 feet of trestle. PWA project under Kentucky Department of Highways, T. H. Cutler, chief engineer; R. G. Smiley, chief engineer L & N Railroad. General contractor, Henry Bickel Co., of Louisville. Piles manufactured and driven by Western Foundation Co., Chicago.

FOR TRACK ELEVATIONS, such as that recently completed by the L & N at Louisville, this type of construction saves on first cost, speeds the job, simplifies handling of traffic during construction, permits utilization of ground and other advantages of open construction, assures low maintenance.

FOR TRESTLE RENEWALS, large concrete piles provide a firesafe, flood-proof, high-reserve-strength, permanent structure at *low annual cost*. Piles may be used in special tower bents as shown. For ordinary trestle heights, standard 3-pile bents can be driven between old stringers—3 to 5 bents per day, with capping and deck slab placement keeping pace.

Write for booklet, *"Concrete Piles—Design, Manufacture, Driving."*

PORTLAND CEMENT ASSOCIATION

Dept. A5-27, 33 West Grand Avenue, Chicago, Illinois

A National Organization to Improve and Extend the Uses of Concrete

UNIFORM BOLT TENSION

Only with spring controlled overload release is this possible

One of the features of the NEW NORDBERG TRACK WRENCH is the uniformity of tightening which can be given to track bolts under all conditions. This is accomplished by an overload release in which the torque is controlled by adjustable spring tension, the only way it can be done accurately and continuously. It should be remembered that springs are also used for engine governors, scales and similar mechanisms which day after day must give unfailing accuracy and require a minimum of attention.

Other features of this new wrench are LIGHT WEIGHT, SPEED and POWER. It is also fully revolving so that operator may always face traffic. With specially developed accessories, this machine can also be used for drilling holes for track bolts and for driving screw spikes.

But 5% Variation Shown By Tests

Variation of torque on the nut is not more than 5 per cent plus or minus, as proved by tests made with a torsion wrench.

NORDBERG MFG. CO.
MILWAUKEE, WISCONSIN
Export Representative
WONHAM, Inc., 44 Whitehall Street, New York City

CHECK THE *plus values*

in

BARCO

GASOLINE TYTAMPERS

on

31 RAILROADS

- LOW INITIAL INVESTMENT
- LOW COST MAINTENANCE—NO EXPENSIVE AUXILIARY EQUIPMENT
- PORTABILITY INSURES MORE PRODUCTIVE HOURS PER YEAR WITH GREATER DIVERSIFICATION OF USES

BARCO

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1805 W. WINNEMAC AVE., CHICAGO, ILL.

THE HOLDEN CO., LTD.
IN CANADA

MONTREAL MONCTON TORONTO WINNIPEG VANCOUVER

Here's one item that belongs on every railroad's

ECONOMY PROGRAM!

Illustrations show the two easy steps in heat treating rail ends (1) Heating with AIRCO-DB Torch and Gases; (2) Quenching.

HEAT TREATING rail ends is one operation that every railroad can afford for the simple reason that it *saves considerably more than it costs.*

It does this because the hardened rail ends withstand batter many years longer than untreated ends. Given regular joint maintenance, the heat treated ends will last the life of the rail. This holds true for new rails as well as those in service —and for frog and switch points.

AIRCO-DB Torches, specially suited for the work, and AIRCO Gases and rapid supply service, combine to make heat treating of track an easy, rapid and economical process.

Our MW field engineers have helped many railroads put the AIRCO heat treating technique into practice and their services are available to all customers. *Remember:* heat treating is not an expense, but an investment that effects substantial savings in maintenance of way costs. Ask us for details.

CLEAR TRACKS TO RAILROAD ECONOMY

Everyone of the following operations offers railroads the opportunity to cut costs. AIRCO is prepared to supply everything needed to perform one and all of them.

- HEAT TREATING RAIL ENDS, FROG AND SWITCH POINTS
- WELDING UP RAIL ENDS
- AUTOMATIC OXYACETYLENE RAIL END CROPPING
- OXYACETYLENE FLAME HARDENING
- OXYACETYLENE AND ELECTRIC ARC WELDING
- LOCOMOTIVE AND CAR SCRAPPING
- FLAME CUTTING LOCOMOTIVE AND CAR PARTS
- HARD SURFACING
- METAL SPRAYING

Full details about any of these operations promptly furnished on request. No obligation. Write for them.

AIR REDUCTION

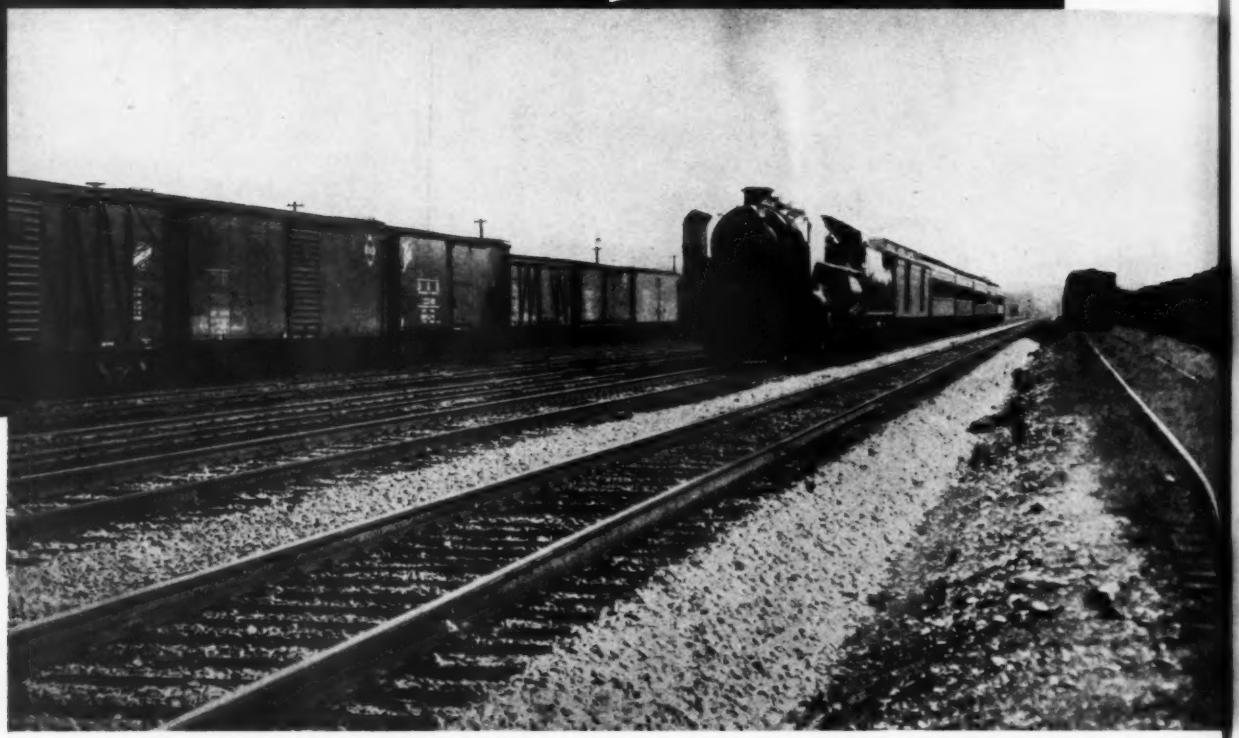
SALES COMPANY

General Offices: 60 East 42nd St., New York, N. Y.

DISTRICT OFFICES IN PRINCIPAL CITIES

SERVING RAILROADS FROM COAST TO COAST

VELVET ~~WELDED~~ TRACK . . . and in more ways than one



Thermit welded track was first nicknamed "Velvet Track" in 1933, by locomotive engineers of the D.& H. So noticeable was the sudden hush and the smooth, gliding sensation when locomotives left the regular jointed rails to roll over the continuous rails of an early installation, that it seemed almost like riding on velvet.

And, now, welded track is resulting in plenty of "velvet" for Maintenance of Way Departments, too. Long, joint-free rails, on stable roadbeds, are proving self-surfacing and self-lining, requiring little if any attention once they are set. Labor savings in maintenance alone are estimated at from thirty-eight to fifty per cent, compared with standard track of the same weight. In addition, there are other savings, such as increased rail life and the elimination of joint bonding and building up of rail ends.

Because of these advantages, the chances are that, sooner or later, you will be considering rail welding. You should, therefore, have full data on the Thermit process. You will be interested in learning how small and how portable the equipment is; how your own track forces can be quickly trained to carry on the work. You will want to know, also, why Thermit welding provides the ideal type of weld . . . a weld in which there can be no slag inclusions; no burning of welded surfaces. Write, today, for complete information.

THERMIT Rail WELDING

METAL & THERMIT CORPORATION, 120 BROADWAY, NEW YORK, N. Y.
ALBANY · CHICAGO · PITTSBURGH · SO. SAN FRANCISCO · TORONTO

REDUCE THE COST OF ROADBED UPKEEP

Here is an example of how a saturated subgrade was corrected by the use of Armco Perforated Pipe. Note water pocket near track.

Poorly drained subgrades are a burdening tax on railway maintenance budgets. Water impounded *under the road surface* means constant repair bills. Then, too, it causes numerous intangible costs—loss of prestige and good will resulting from expensive "slow" orders and rough-riding track.

Fortunately, you *can* eliminate these hidden trouble-spots in subgrades. Installing ARMCO Perforated Pipe will keep ballast free of water and prevent the formation of deep, saturated pockets that hasten failure of rails, ties and ballast.

Many railways that have drained and stabilized their roadbeds are now benefiting from low maintenance cost at a time when these savings mean the most. Let an ARMCO engineer help *your* staff achieve similar results. Just address: Ingot Iron Railway Products Company (member of the Armco Culvert Mfrs. Assn.), Middletown, Ohio; Atlanta, Salt Lake City, Los Angeles, Minneapolis, St. Louis, Spokane, Portland, Houston, Cleveland, Philadelphia, Berkeley, Calif.; Richmond, Virginia; Dallas, Texas; Denver, Colorado; Chicago.

ARMCO **PERFORATED PIPE**

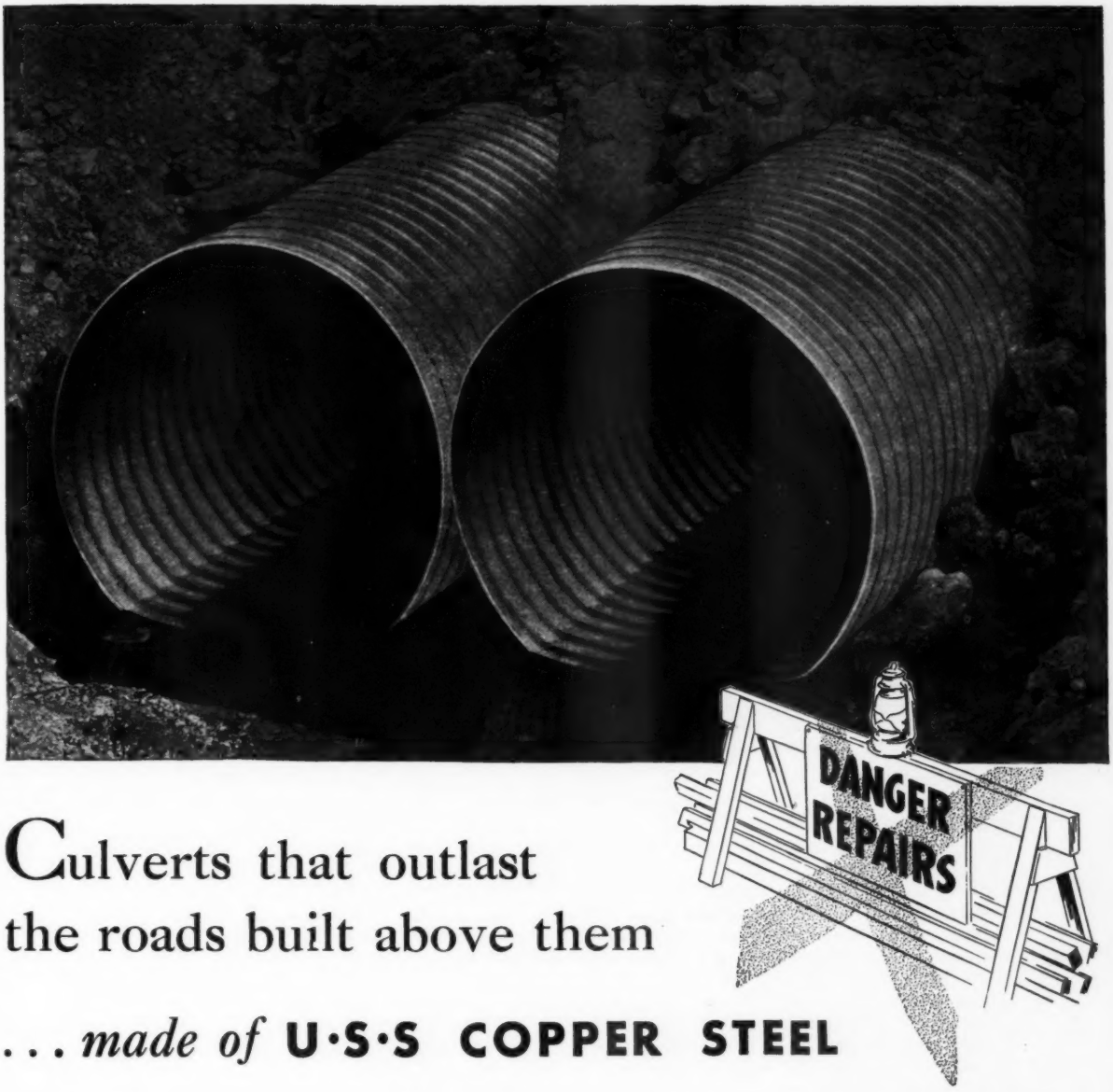
TO RAILWAY SUPPLY MANUFACTURERS

When Economy Is The Watch Word

every manufacturer is forced to consider sales expenses. In such times, advertising presents a special appeal.

In what other way can one keep his products before railway maintenance officers, at headquarters and outlying terminals alike, for less than three cents a call a month—in a form that goes direct to their desk by request (subscription) and that they take with them out on the line?

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS



Culverts that outlast the roads built above them

. . . *made of* U·S·S COPPER STEEL

CONVINCING evidence of the great strength and correct design of U·S·S Corrugated Copper Steel Culverts is shown by service records. Since 1911, when U·S·S Copper Steel was first introduced, no culvert of this metal has ever been known to fail from structural causes. This means that U·S·S Copper Steel Culverts will withstand all of the weight, impact, strain and shock for which they are designed and still have an ample margin of safety.

While these mechanical features are important, they must be combined with durability to assure best results in service. U·S·S Copper Steel gives maximum resistance to corrosion. For culverts it combines strength and low installation cost with substantial endurance. U·S·S Copper Steel culverts outlast the roads under which they are installed.

In addition to copper steel, we make plain galvanized steel and pure iron galvanized. Write for our culvert book on these materials.

U·S·S GALVANIZED CULVERT SHEETS

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

No. 113 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: A Plus Service

Dear Reader: May 1, 1938

"If you are advertising in the export magazines to help me sell your equipment in this part of the world, I wish that you would transfer this advertising to Railway Engineering and Maintenance, for that is the magazine that I find railway officers here reading when I call on them. It is the magazine for which they subscribe in order to keep abreast of maintenance practices. It is the magazine to which they turn when in need of equipment like ours. It is the magazine in which advertising of our equipment will help me most".

This was the gist of a letter that a prominent builder of work equipment in the Middle West received a short time ago from his sales representative in an important railway center in the Southern hemisphere. It throws the spotlight on a segment of our family of readers that we seldom emphasize; yet one of which we are very proud, for it comprises the very cream of the railway maintenance officers outside North America. Furthermore, unlike the export magazines, which are largely distributed gratis, every subscription to Railway Engineering and Maintenance evidences a definite desire for the magazine, as demonstrated by the payment of the full subscription price, for we have no free circulation at home or abroad.

These subscriptions (more than 350 in number from countries outside the United States, Canada and Mexico) go to every continent and every country where there are railways and railway maintenance problems. They go to Coatepeque, Guatemala; Buenos Aires, Argentine; Sao Paulo, Brazil; Antofagasta, Chile; Lima, Peru; Anam, French Indo-China; Tsinan, China; Bombay, India; Haifa, Palestine; Bangkok, Siam; Tokio, Japan; London, England; Dublin, Ireland; Uprawlen, Turkestan; Leningrad, Russia; Elizabethville, Belgian Congo; Ebute Metta, Nigeria; Bulawayo, Rhodesia; Atbara, Sudan; Wellington, New Zealand; Brisbane, Australia; and to many other points throughout the world where there are tracks and structures to maintain. I have before me, as I am writing this letter, a letter that I have just received from a subscriber on the Tanganyika Railway in Central Africa who states that he "finds Railway Engineering and Maintenance of great interest and value".

This widely distributed circle of readers indicates a very direct interest in American railway practices. It indicates also that these readers are finding American practices adapted, in some degree at least, to their conditions.

And this circulation also carries to these remote corners of the earth, the stories of those American materials and equipment that are presented in our advertising pages—a service to which little thought may have been given by those manufacturers who are using these pages primarily to reach the American market. Yet, I happen to know that some of our advertisers are finding this world market especially attractive at the present time when purchases at home are at a low ebb.

Yours sincerely,

Elmer T. Howson

ETH:EW Editor

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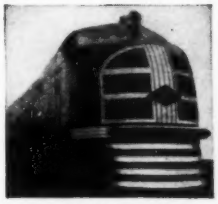
In Air Compressors Or Streamlined Trains TIMKEN Bearings Assure Maximum Performance

Tapered Roller
TIMKEN BEARING
EQUIPPED

A symbol of quality for any piece of equipment with which it is associated

TIMKEN Roller Bearings assure low maintenance costs and greater operating freedom in all kinds of modern railway maintenance equipment as well as in modern rolling stock.



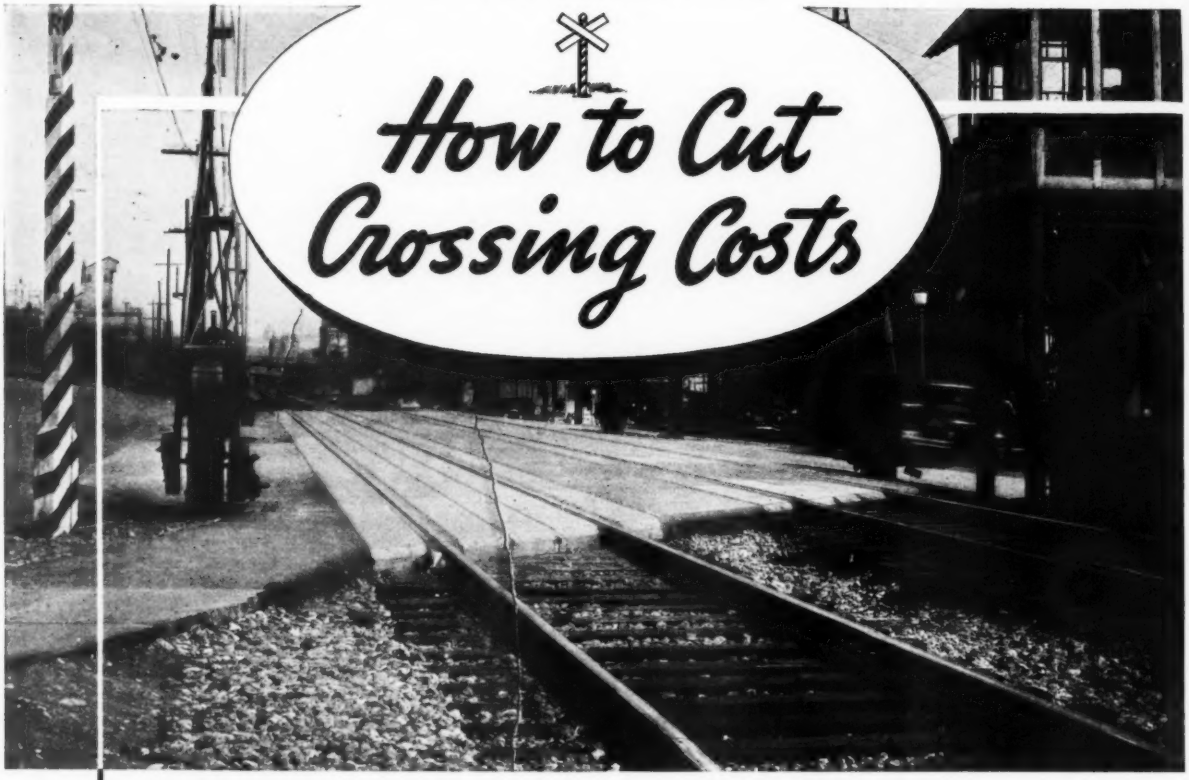
THE GREEN DIAMOND, Illinois Central Railroad.* Speeds Smoothly On TIMKEN Roller Bearings.

GLIDE—as you ride a Timken Bearing Equipped train

The Ingersoll-Rand Crawl Air Compressor pictured above furnishes the power for tie tamping on the St. Louis, Brownsville and Texas Railroad. The crankshaft of this compressor is mounted on TIMKEN Bearings assuring maximum life with minimum attention. The crankshaft is securely held in alignment, wear is eliminated along with power consuming friction, and all radial-thrust loads are carried with a margin of safety. When buying anti-frictionized compressors it will pay you to specify TIMKEN Bearings.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
TAPERED ROLLER BEARINGS



How to Cut Crossing Costs

Use TRUSCON Weltrus Crossings

Truscon Weltrus Highway Crossings are easily installed. No special tools are required. They are made in various heights to conform with height of rail and tie plate and in various lengths and widths to meet specific conditions. All details are fully explained in the Truscon Weltrus Highway Crossing Catalog. Send for a copy.

• Where factors of railroad and highway traffic *density* and *speed* make crossings of vital importance, TRUSCON Weltrus Crossings provide the all-inclusive solution to the many variables encountered. • Cost of Weltrus Crossings on an annual basis are held remarkably low when their long service life and economy of maintenance are properly considered. • A fundamental and unique feature of Weltrus Crossing slabs is the pouring of the concrete into the welded steel units. Each form combines both the necessary reinforcing and armoring of the concrete slab, its sides and ends . . . *complete protection!* • Wood flangeway blocks fit under the rail head, while the rib at the side of the blocks engages the groove in the side of the Weltrus section. Consequently, when the wood splines are driven between the center sections, the crossing is keyed between the rails. Creosoted wood splines form a continuous dowel pin the full length of the sections and carry the traffic loads from slab to slab. • These and other *COST-SAVING* advantages are explained in the Truscon Weltrus Highway Crossing Catalog. Write for a copy NOW!

TRUSCON
Steel company
YOUNGSTOWN · · · OHIO
57 SALES ENGINEERING OFFICES
SUBSIDIARY: REPUBLIC STEEL CORPORATION

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

MAY, 1938

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The Employee—True Consensus—Ties—An Emergency

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In this paper, C. B. Bronson, inspecting engineer, New York Central, discusses rail conservation and manufacture

Meeting the Test at a Bridge Burn-Out - - - - - - - - 316

Describes how the New Haven organized for and rapidly rebuilt a main-line timber trestle destroyed by fire

Getting Down to Details on the B. & M. - - - - - - - 319

This article tells of the self-conducted meetings of the track and bridge and building supervisors on this road

Rail Production Hits Peak in 1937 - - - - - - - - - 321

Rollings totalling 1,445,739 gross tons reach seven-year high. Production was 225,893 tons greater than in 1936

Moves Small Station on Flat Car - - - - - - - - - 322

One and one-half story structure, 90 ft. by 24 ft. in plan, transported 44.5 miles in this manner on Canadian Pacific

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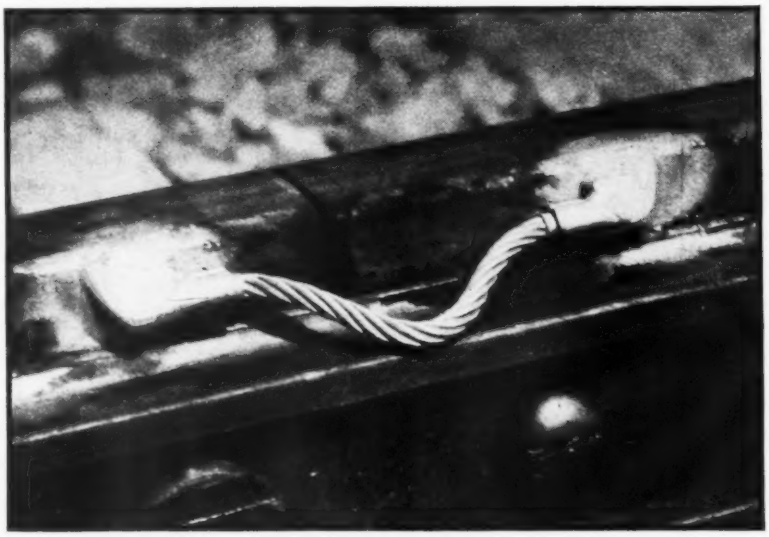

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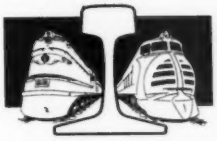

The Employee

A Partner in Transportation Production

THE railways constitute a vast manufacturing industry. Their product is transportation—the moving of persons and of materials from one place to another. This product is measured in passenger miles and in ton miles. The output last year approximated 24,852,000,000 passenger miles and 362,000,000,000 ton miles.

To produce this volume of transportation required the co-operation of a staff of 1,118,000 men and women. This vast organization included those who operated the trains, those who maintained the cars and locomotives by means of which this traffic was moved, those who sought out and sold this business and those who compiled the records necessary for the proper accounting for each transaction. It included those officers who directed and co-ordinated the activities of their fellow employees to the end that the public received adequate and efficient transportation service; it included also the more than 230,000 persons employed in the maintenance of the tracks and structures, whose work lies at the very foundation of safe and dependable service. All these employees contributed, each in his essential way, to the production of that service that is so vital to the life, well-being and comfort of the public—transportation.

Three Parties of Interest

But in the consideration of railway transportation three groups are vitally interested; the public, the employees, and the investor. No one of these three can be ignored or neglected long without disaster. Each must be considerate of the others.

The public is interested in efficient service at low cost. As the buyer, it is in a position to choose between the various services that are available to it today on the highways, on the waterways and in the air as well as on the rails. If the railways are to win and hold its patronage, they must meet its needs and its desires as to service. Equally important, they must provide this service at a price that the public is willing to pay.

That there is a very sharply defined upper limit beyond which railway rates cannot go is not always realized—a limit fixed in part by competitive agencies and in part by public regulatory bodies. Highway competition presents an illustration of the first form of control, the decision of the Interstate Commerce Commission a few weeks ago illustrates the second. It is evident, therefore, that the amount that the public will pay the railways for transportation is fixed within very definite limits.

The Employees

As the second party of interest in the transportation industry, the employees look to it as a means of livelihood. From it they gain the income to support themselves and their families. Of the $4,166,000,000 that the patrons paid the railways for service last year, the railways paid $1,985,323,000 to their employees as compensation. In other words, the employees received 47.1 cents of every dollar earned by the railways, the highest ratio in history; it compares with 45.6 cents in 1936 and 40.8 cents in 1916. And in the first two months of 1938, the proportion going to employees increased to 53.5, in spite of a reduction of nearly 136,000 in the number of persons employed, as compared with the same two months of 1937.

But let us pursue the breakdown of the railway patron's dollar still further. Reverting again to 1937 figures, in addition to the 47.6 cents that went to labor, approximately 23.2 cents went for crossties, rails and other materials and supplies required in the normal operation of the railways; 7.8 cents went for taxes of all kinds; 7.2 cents for loss and damage payments, injuries to persons, insurance, depreciation and retirement of equipment, and for hire of equipment and joint facilities. These various amounts total 85.8 cents, leaving 14.2 cents for the payment of fixed charges and dividends.

The Investor

This brings us at once to the consideration of the third party of interest in transportation—the investor. It is obvious that a railway cannot operate without patrons; it is equally obvious that it cannot operate without employees; it should be, but frequently is not, equally evident that a railway is helpless without tracks, equipment and

allied facilities and that these facilities are provided only by the expenditure of capital. This capital is made available through the purchase of railway bonds or shares of stock from their savings by railway employees and others who anticipate that they will secure a return therefrom equivalent to that possible through the purchase of a home or other investment.

In the aggregate, the railways represent an investment of $25,700,000,000. This includes the money spent for the cars and locomotives, the tracks, bridges and buildings and all those other facilities that go to make up a railway. It represents an investment per employee of $22,987. In other words, the production of transportation in 1937 was made possible by each employee working hand in hand with $23,000 that was placed at his disposal by investors who expect a return therefrom. It was through this partnership that each unit (one employee plus $23,000) produced for the public an average of 324,000 ton miles and 22,000 passenger miles of transportation last year.

Essentials of Partnership

It has long been recognized that no partnership will long survive in which either partner receives an inadequate division of the proceeds. In the division of the patron's dollar, it was shown above that the employee is now receiving the largest portion in railway history; conversely, the railway investor is now receiving a smaller proportion than ever before. In 1937, the rate of return earned on the property investment of the railways was only 2.30 per cent. It was 0.16 per cent in the first two months of the current year. This compares with an investment return of 4.99 per cent in 1926 and 5.90 per cent in 1916.

Stated in another way, after deducting the amounts paid for materials and supplies, for ties, for loss and damage, injuries to persons, insurance, depreciation and retirement of equipment and for the hire of equipment and joint facilities, there remained approximately $2,575,504,000 for distribution between the employees and the owners of the railways; of this, the employees received $1,985,000,000, or 77 per cent, and the owners $590,000,000, or 23 per cent. In other words, during the year 1937, the employee (one unit in the partnership) received 3-1/3 times as much as the owner (the other unit in the partnership).

Trends Significant

These trends are highly significant. They point to the cause of the present crisis in the railway industry —the lack of a return to capital sufficient to prevent its flight into other forms of investment. At first thought, this condition might be considered to be of no concern to the employees but rather to be a problem exclusively for management.

But the matter cannot be dismissed so lightly, for when the railways cease to be attractive to those who have savings to invest, they will become a stagnant industry and a stagnant industry provides less employment, with even smaller chances for advancement for those who accept employment with it.

This problem is not insurmountable but its proper solution requires the best thinking of everyone within the industry in order that the relationship between employee and investor may be restored to that basis which brought our system of railways to the highest level of efficiency in the world.

Ties

Better Service Life Through Supervision

INTENSIVE study and much effort have been devoted to the development of methods for assuring better-quality ties, with the result that the tie is under constant supervision from the time the tree is felled, through the seasoning period and during treatment. Strangely enough, considering that ties represent the largest item of maintenance expense, when they leave the treating yard this strict control is relaxed and the ties are consigned to the tender mercies of a great number of widely separated gangs.

Few of the foremen in charge of these gangs, and still fewer of the men comprising them, have any knowledge of the extreme care that has been exercised to bring to them a high-grade product that has a potential service life equal to that of the men who will be engaged longest in their present employment. Lacking this knowledge, and under constant pressure to get more work done with reduced forces, it is small wonder that after the ties are in the track they do not always receive the same consideration that is given to them during their manufacture.

Formerly, decay under the rail was the most important cause of tie failure, and even today ties that have been preadzed, prebored and adequately treated, fail in large numbers from the same cause. In fact, so large a percentage of the failures result from decay under the rail that if this could be eliminated or reduced, the average life of ties could be notably increased. Obviously, decay under the rail cannot be eliminated completely, and it is not contended that it can, but one has only to watch an average section gang for a short time to be convinced that it can be reduced.

Decay under the rail is invariably the result of mechanical abuse, a factor that should be negligible for treated ties that are prebored and protected with plates of adequate area. Spike killing, with its accompaniment of decay, is the most frequent cause of this type of failure, while neglect to use tie plugs also shortens tie life. Even when driven into prebored holes, spikes cause considerable distortion of the wood fibre. When withdrawn, the hole should be plugged with a treated tie plug, regardless of whether the spike is to be redriven. When redriven, it should be returned to the hole from which it was withdrawn; replacing spikes by driving them into unused holes or by driving them into solid wood can only result in definitely shortening the life of the tie. Furthermore, a spike once driven should be let alone until necessity demands its withdrawal. In general, spikes work up because of defects in surface, and these should be corrected to prevent this action. Tapping a spike down damages the wood fibre and lessens its holding power.

Although these are matters of common knowledge among trackmen, they continue careless practices in spik-

ing that destroy thousands of ties annually long before their normal life is completed. If the same intensive effort were exerted by foremen and supervisory officers to conserve the life of ties after they are in service that is exerted in their manufacture to produce ties of long potential life, the remarkable record of the modern tie would be better than it is.

An Emergency

How the Engineering Department Met It

WHEN a catastrophe occurs, such as that which, without warning, confronted the engineering officers of the railways in Southern California on the morning of March 2, the vital question is not its magnitude, important as this is, but how the emergency will be met. A disaster of this magnitude rarely occurs oftener than once in a lifetime, and the men who bear the brunt of restoring service on the devastated railways have seldom passed through equally severe experiences. It is, therefore, all the more to the credit of the officers of these California railways that, although they did exactly what might have been expected of them, they were not appalled by the task that faced them, but undertook it with such courageous energy and resourcefulness that they made a remarkable record of quick recovery from almost complete devastation.

Without information as to the extent of the disaster and completely isolated, they began at once to build emergency organizations that included men, equipment and services of supply. Lacking sufficient equipment of their own, they quickly arranged with contractors to supply the deficiency. Then, unable to move it to the points where it could be used most effectively, they cleared highways and built temporary highway bridges to make the passage of the equipment possible.

In short, routine had no place in the methods that were followed, and there were no rules to go by; every problem was an individual one that called for maximum resourcefulness on the part of those who carried the responsibility for its solution. Yet the procedure was orderly, and every move was co-ordinated with the main objective, that of early restoration of train operation over the affected lines.

As information began to come in it became evident that the task comprised nothing less than that of rebuilding miles of destroyed track and roadbed; of clearing other miles of track that were buried under deposits of boulders, gravel and silt, some of it as much as 20 ft. deep; and the replacement of thousands of feet of bridges, with a premium on every hour of time consumed in doing the work.

That the job was done so quickly and so well in the face of almost insuperable difficulties is a remarkable demonstration of the ability, resourcefulness and energy of the officers who bore the responsibility and carried it through. It is an equally remarkable demonstration of the unfailing loyalty, the stubborn determination and the individual resourcefulness of the men on the firing line who labored night and day to complete the work of restoration.

A True Consensus

Requires Unrestricted Expression

IT IS an old saying, fully appreciated and applied in the railway industry, that two heads are better than one—witness the many associations of railway men, from those of national scope down to the smallest group meetings of foremen on individual subdivisions. Whenever railway men get together there is community of interest and, more frequently than not, a freedom of thought and expression, factors which have led to the success of so many railway organizations. In fact, these factors are essential to the most effective results of any organization, especially the latter factor, if it is to crystallize the consensus of the greatest number in the shortest possible time. In other words there must be open and frank thought and expression, free of abnormal restraining influences, whether they be real or imagined. While this holds true in all railway organizations, it is particularly so of groups of supervisory officers of the lower ranks where inexperience, lack of seniority, inability of expression or actual fear of conflict with the ideas of superior officers may restrict an otherwise active flow of constructive reasoning and expression.

In recognition of this fact, the supervisors of track and of bridges and buildings on the Boston & Maine have been encouraged for more than 20 years to conduct their own meetings, wherein, as described in an article in this issue entitled "Getting Down to Details on the B. & M.," the men discuss their everyday problems, concerning their own welfare as well as their work and the railway as a whole, unrestrained or unrestricted by any official influence, even so much as the attendance of a superior officer, unless this officer is specifically invited in the interest of a particular problem under consideration. In short, the supervisors on this road meet with men of equal rank, and, as a result, have no hesitancy to express their candid opinions. As a result, they get down to the basic facts in every case; are as free to take issue with the existing order of things as they are to foster and promote established methods and practices, and their record bears out the fact that their constructive criticisms have been as helpful as their new ideas and suggestions.

In view of the harmonious relationship and the degree of understanding that exists between officers of various ranks on the Boston & Maine, and the general esprit de corps among its employees, it is questionable to what extent the special character of the supervisors' meetings on this road has had a bearing upon the subjects discussed or the results accomplished, but it is a fact that under the arrangement existing, the road gets exactly what it has sought and continues to consider of great value—a true consensus of its supervisors on matters within their realm. The officers of the road testify to the effectiveness of this arrangement, which they say has had a marked effect on the well-being of the men, and in the promotion, general adoption and carrying out of the safest and most effective and economical practices.

WABASH PROGRAM—Permission to spend $1,235,400 for repairs to 300 box cars and to roadbed was asked by the Wabash in a petition filed with the federal district court at St. Louis, Mo., on April 23.

California Roads Make Rapid Recovery from Flood

FOLLOWING the worst storm of record in Southern California, all of the railways in the Los Angeles area suffered severe and widespread damage through slides, washouts, destroyed bridges and deposits of debris on their tracks. In some instances tunnels were blocked and bridges were buried under accumulations of logs and sand. In not a few cases streams cut new channels that occupied the former site of the roadbed. Yet despite the extent of the damage, the affected roads were restored to service in record time, considering the amount of work involved and the apparently insurmountable obstacles with which they were confronted as a result of interrupted communications and impassable highways.

Rainfall Was Abnormal

The storm, which began with a heavy rain on the morning of February 27 and continued without interruption until March 4, developed into cloudburst proportions on the evening of March 1, and continued without abatement during the following day and night. While a total of 11.15 in. of rainfall for the entire period of the storm was recorded officially by the weather bureau at Los Angeles, with 6.03 in. in the 24-hr. period ending at 4:30 a.m. on March 3, it is the common testimony that the precipitation was much greater north and east of the city, especially throughout the San Bernardino mountains, as far north as the Tehachapi range and beyond the Nevada line on the east.

As a result of this abnormal precipitation over so wide an area, bridges were swept away, embankments melted under the impact of the flood waters, cuts and tunnels were blocked by heavy boulders, silt and other debris that were washed in, and slides occurred all through the mountain territory. Highways were similarly affected, many sections of pavement disappeared or were undermined, roads were blocked by slides, bridges were washed out, and elsewhere travel was made unsafe or impossible by the debris which covered miles of roadway. To add to the general confusion produced by the complete paralysis of rail and highway traffic, telegraph, telephone and signal lines were also severed all through the area affected by the storm, making it impossible to ascertain the extent of the damage for some time.

In short, with practically no warning, the railways in the entire Southern California area were confronted with a major disaster that involved hundreds of miles of lines, and included tracks, embankments, bridges, engine terminals, yards, signals, dispatching facilities and other means of communication. Efforts to penetrate into the flood-stricken area on foot or by highway were halted by swollen streams and washed-out bridges. Furthermore, the whole situation was made more difficult by the fact that the damage was not confined to certain restricted areas, but was general throughout the entire territory affected by the storm, since there was scarcely a single mile of the hundreds of miles involved that did not suffer its quota of damage.

While it was evident from the fragmentary information that was available at the beginning, before the communication lines went out, that considerable damage had occurred, it was impossible to visualize

Extreme Left—In Soledad Canyon, Three-Span Crossing of Santa Clara River and Highway Bridge Washed Out. Left—In Cajon Canyon, the Tracks Here Were Buried Under 20 Ft. of Boulders and Gravel

Despite the worst storm of record in Southern California, and despite damage to their lines that reached the proportions of a major disaster, the railways in that area were able to restore traffic in record time, considering the amount of work involved and the exceedingly difficult conditions under which it was necessary to do it. This article describes the manner in which the Southern Pacific and the Atchison, Topeka & Santa Fe organized to meet the emergency and the remarkable manner in which a large amount of power equipment and material were mobilized in the devastated territory at a time when communication was cut and the highways were impassable. Engineering and operating officers performed a remarkable feat in the restoration of their lines under these most adverse conditions.

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the actual situation until the highways had been cleared sufficiently to make it possible, by following devious routes, to reach interior points on the various lines affected. Even after this became practicable, damage to the lines continued to occur for some time until the rain ceased and the water in the mountain streams began to subside.

Yet, despite the magnitude of the disaster, which affected lines of the Southern Pacific, the Union Pacific and the Atchison, Topeka & Santa Fe for distances of more than 100 miles in all directions from Los Angeles, and before its full extent became known, these roads began to mobilize their maintenance forces and equipment to the end that the work of restoration might proceed promptly from as many points as were accessible.

Recognizing that the railway-owned equipment in the area would be insufficient to meet the requirements of the emergency, arrangements were made with contractors for the use of all equipment they could provide that would be suitable for the work of restoration. Likewise, it was obvious that a large expansion of the forces would be necessary to cope with the emergency, and men were hired wherever they could be obtained and incorporated into the regular organization or were brought in with equipment and materials from other parts of the lines. A description of the restoration work on the Southern Pacific is given in the following.

The Southern Pacific

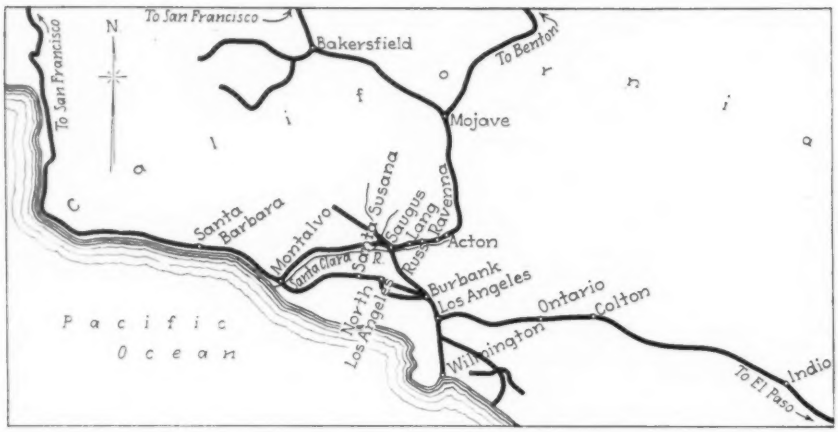
The Southern Pacific has three main lines radiating from Los Angeles, one to the east through El Paso, Tex., to New Orleans, La.; and two to the north to San Francisco. Of the latter, one follows the Pacific Coast, and the other, farther inland, traverses the San Joaquin Valley, passing through Mojave and Bakersfield. The storm was especially severe in the area through which the San Joaquin Valley line is located.

On the Coast line, which was subjected to the least damage, three bridges were washed out, and the piers of another bridge were undercut, but did not settle or go out of line. Slides and washouts occurred at a number of points and at several places embankments settled to such an extent that it was necessary to restore them before traffic could be resumed.

On the El Paso line 1,000 ft. of pile and frame trestles were washed out at 8 points; 4,000 ft. of embankment was destroyed at 15 separate places; and 5,000 ft. of side wash occurred along embankments at 8 places, all between Los Angeles and Indio, 130 miles. At Colton, 60 miles east of Los Angeles, Lytle Creek cut a new channel directly across the freight yard, burying the remainder of the yard, the turntable and the enginehouse pits to a depth of 3 ft. with sand and silt, at the same time undermining a number of yard buildings and several tracks that were occupied with cars.

In Los Angeles, the important bridge at Dayton avenue, which carries the passenger tracks across the Los Angeles river, was washed out, and the embankment forming the approach to the Arroyo Seco bridge on the opposite side of Dayton avenue, carrying the double-track freight line, was destroyed.

Damage on the San Joaquin Valley line was much more extensive, reaching as far as Bakersfield, 170 miles, with minor damage as far north as Madera, 300 miles. On this line slides occurred in cuts in the Tehachapi mountains, in Soledad canyon, one of which blocked the entrance to a tunnel, and two other tunnels were partly filled with washed-in debris. Culverts were filled with sand and gravel and the tracks were washed out at numerous places for distances up to several hundred feet, while side washes were



The Southern Pacific Has Three Lines Radiating from Los Angeles, All of Which Were Affected by the Flood

still more numerous. Between Russ and Lang the Santa Clara river washed out five steel bridges and buried four others under accumulations of logs and sand, besides completely destroying four miles of track and roadbed. Between Russ and Acton the line was made impassable for 10 miles by destroyed bridges and side washes.

Forces Mobilized Quickly

The extent of the disaster could not be ascertained for some time, since the entire section was isolated by failure of telegraph and telephone systems as well as by inability to penetrate into the afflicted area except on foot and even this mode of travel became impossible at many points because of swollen streams and washed-out bridges. Yet despite these difficulties, mobilization of the forces necessary to start restoration work began almost as soon as the line was broken. Although without communications, section foremen hired men and started to repair the damage as best they could. Officers arranged for suitable outside equipment wherever it could be obtained, and men, equipment and materials were sent from other divisions as soon as information on the extent of the disaster became available.

Plans were formed quickly to utilize mobile equipment on crawler mountings since they could be moved over the highways even before they became passable for vehicles. In this way work was started at many interior points and carried on simultaneously while other forces were progressing from the ends.

Equipment Was Invaluable

Equipment of every type adapted for the purpose was utilized, that owned by the railway being supplemented by machines and operators obtained from contractors. Motor trucks were used to handle men and materials, proving invaluable for reaching points that would otherwise have been inaccessible, besides saving much time in getting materials to the points when it was needed. Both gasoline and Diesel-powered shovels and draglines were used to advantage, in some cases in connection with motor trucks, in restoring embankments and clearing slides. In addition, tractor-drawn carry-all scrapers were used effectively in the larger grading operations. Tractors equipped with bulldozers were especially effective for restoring embankments that had been subjected to side wash, as well as for clearing tracks that had been covered with debris. Truck-mounted cranes were used by the bridge forces to handle heavy timbers and set up framed bents, saving much time by reason of their mobility, as compared with rail-mounted cranes, since they could work ahead of the track restoration.

Railbound machines included pile drivers, bridge cranes, wrecking cranes, rail cranes, air compressors, spike drivers, bolting machines and other similar units. The air compressors were used by both track and bridge gangs, proving exceptionally valuable as time savers for boring bridge timbers. The larger cranes were used for unloading heavy riprap as well as for handling other heavy materials, including rail from cars to trucks. To cite a particular case, two wrecking derricks unloaded heavy riprap for 48 hours around the piers of the 35-span bridge over the Santa Clara River bridge at Montalvo, on the Coast line, which were scouring badly, and thus saved the structure.

As the largely increased forces

In Soledad Canyon Near Lang. Crawler Equipment Was Particularly Effective Because of Its Mobility. Note Six Tractors with Bulldozers and Two Draglines

engaged in restoration were scattered over several hundred miles of line, it became necessary to supplement the local supervisory forces, for which purpose supervisors, foremen, and engineers and their staffs were drawn from other divisions. In a disaster of this magnitude where the forces are suddenly increased and gangs must be moved quickly from place to place to meet the exigencies of the situation, more or less confusion attends the keeping of the time rolls and the records of material used. To overcome this situation a special staff of auditors was organized to supervise the time-keeping, to record the receipt of materials and to make the necessary charges as it was used.

Important as men and power machines were, the work of restoration could not have been carried out without an ample supply of materials. Storehouses serving the flooded area are maintained at Los Angeles, Bakersfield and Oakland. As a part of the emergency organization the storehouse forces at these points were divided into day and night shifts to insure the quickest despatch of materials as they were ordered. To reduce waiting time, these supplies were moved by special trains to the points most accessible to the places where they were needed, and from these points they were taken to the front by motor trucks.

Materials for the construction of trestles were also shipped from points as far distant as Tucson, Ariz., 503 miles, and El Paso, Tex., 815 miles. Other materials, including hand tools, not in stock were purchased as needed wherever they could be obtained.

In organizing for the work of restoration the railway's own forces provided the nucleus around which the larger organization was built. In addition to the men brought in from other divisions, new men were hired locally to increase the size of the regular gangs or the number of gangs. Where equipment was obtained from contractors an effort was made to secure with it men who were experienced in its use.

Typical Examples

Owing to the widespread destruction which resulted from the storm, only a few examples of the rehabilitation work can be cited. At Colton, where 450 feet of approach embankment to the bridge over the Santa Ana river was washed out, a temporary frame trestle on mud sills was constructed as the quickest means of bridging the gap. While the pile driver and crew from Yuma, Ariz., were constructing trestles over washouts farther east, the bents for this structure were framed and assembled in the shop yard at Los Angeles. They, together with the stringers and ties, were then transported to Colton by motor truck and loaded on flat cars to be taken to the bridge. Here they were unloaded and placed by an auto-truck derrick. In this way the trestle was completed at the rate of one span an hour.

At some of the washed-out bridges the steel was buried in the sand so close to the alinement that it interfered with the construction of frame or pile bents, or the washed-out masonry offered similar obstruction. In these cases the track was carried around by means of shoo-flies on embankments or temporary trestles to save the time necessary to remove the steel or tipped-over piers.

In other cases corrugated pipes, box culverts or short trestles were installed and embankments were constructed to save time. It was possible to do this as a temporary expedient for many of the streams are normally dry and the water receded almost as quickly as it rose, leaving the channel dry or with only a minor flow. In many instances the auto-truck derricks saved much time in the construction of the necessary openings since the material was delivered by motor truck and erected with the derricks well ahead of the track restoration.

In not a few instances the work of restoration was complicated by the fact that parallel streams not only washed out long stretches of embankment, but cut new channels that occupied the site of the roadbed. At these points it became necessary, therefore, to excavate new channels before the embankments could be restored.

As mentioned, the San Joaquin Valley line suffered the most extensive damage, the severest of which was south of Mojave although there were numerous washouts between that point and Bakersfield. Between Acton and Saugus, the line follows the Santa Clara river, for the most part in a narrow canyon, where the high velocity of the confined water swept away track, bridges and roadbed. In the four miles between Lang and Russ nothing remained except four bridges that were buried by logs and sand. In the next 10 miles to Acton the track remained, but little else.

In this section, bridge and building gangs started at the north end with pile drivers, but installed framed bents wherever practicable, since they could be erected in less time than the piles could be driven and capped. Access with rail equipment could not be gained immediately from the south end since two fills aggregating 30,000 cu. yd. had disappeared and had to be replaced. In the meantime as much crawler-mounted equipment as could be secured was assigned to the points where it could be used to best advantage in getting the line open. Draglines, power shovels, 75 and 90-hp. tractors with bulldozers, carry-all scrapers pulled by tractors, and motor trucks were put to work on the two large fills at the south end.

As these operations required some time, to avoid delay in replacing the

The Dayton Avenue Bridge Carrying the Passenger Track Across the Los Angeles River as it Was Dropping Into the Stream

four miles of track between Russ and Lang, rail, ties, joint bars, bolts, spikes and tie plates, as well as rail cranes, air compressors, spike drivers, bolting machines and all incidental tools were hauled in by truck to a central point from which track construction was carried forward to the north and south as rapidly as the roadbed was restored. In this way, the four miles of track was laid and was ready for ballast as soon as the 10 miles to the north was completed and the track could be connected over the large fills at the south end.

This part of the line lies in a narrow canyon that is not readily accessible except at the ends and at one or two other points. The manner of reaching the central point which was chosen as the place to begin track laying is, therefore, of interest, especially as it is typical of similar difficulties encountered elsewhere throughout the storm area. The only highway route available involved a detour of 23 miles by the trucks hauling track materials and equipment to reach a point only three miles by rail from Lang. A similar detour from Acton, the nearest siding on the north where men and materials could be delivered from rail to trucks, was necessary to reach a point only 9½ miles distant by rail.

As rapidly as the line was completed from the north, ballast trains followed, to place the track in condition for operation, while ballast was also brought in from the south as soon as the two large fills at that end were completed. In the meantime telegraph, telephone and signal gangs were engaged in restoring these facilities, the communication lines being cut through temporarily pending permanent restoration by means of transfer cables placed along the hillside.

Similar methods were employed elsewhere over the affected territory, and many thousands of yards of heavy riprap was placed to prevent side wash in the future. Commercial quarries and stone-crushing plants were drawn on freely to obtain the large quantities of ballast and riprap that were required in the work of restoration.

While many of the extra men required on this work were hired locally, they were moved from place to place as the constantly changing situation demanded. To solve the problem of housing and feeding these temporary forces, where no local accommodations were available, as in the Soledad canyon, tent commissaries were set up and all equipment and supplies were brought in by truck. The usual boarding outfits were used for the men employed at Acton, and these were moved to Ravenna when the restoration work progressed to that point. Boarding outfits could not be used at the south end of the Soledad Canyon work, since this work was not accessible from this end until the two large fills were completed. Similar outfits were used for the men working west from Indio.

Despite the magnitude of the disaster, traffic was resumed in a remarkably short time, considering the amount of work involved and the difficulties under which it was prosecuted. Although three bridges were washed out on the Coast line, and the track was cut by numerous washouts, side washes, slides and settled embankments, this line was opened on the morning of March 5, thus providing a route to San Francisco, this being the first line opened into Los Angeles. The El Paso line was opened on the evening of March 8, despite the fact that the highways in this section remained impassable until March 5, thus delaying the despatch of materials and supplies to a number of critical points where they were needed.

Owing to the greater extent of the damage suffered on the San Joaquin Valley line, the larger mileage involved and the greater difficulties experienced in gaining access to many of the isolated points where damage occurred, it took somewhat longer to complete the work on this line, but despite the difficulties, the magnitude of the work involved and the quantities of materials that had to be transported by highway over long and devious routes, this line was placed in service on the evening of March 15, when the San Joaquin Flyer resumed its regular run.

The Santa Fe

Although the Atchison, Topeka & Santa Fe suffered damage comparable with that of the Southern Pacific, its line having been washed out or covered with debris at 125 places, it attacked the problem of restoration with equal energy and was able to replace its lines in service in record time, considering the amount of work that had to be done at widely separated points.

This road crosses the San Bernardino mountains between Barstow and San Bernardino, 81 miles. From the latter point there are alternate single-track lines to Los Angeles, one by way of Pasadena, 60 miles, which closely parallels the southern slope of the mountains, and which is used principally by passenger trains; the other, farther to the south, is a low-grade line through Riverside, Corona, Atwood and Fullerton, 71 miles, used principally for freight movements. From Fullerton the line from Los Angeles continues south through Orange, Santa Ana and Oceanside to San Diego, with a connecting line between Atwood and Orange. In addition, there are numerous branches throughout the sections occupied by the primary lines.

Extent of Damage

The most severe damage occurred between Barstow and San Bernardino, where an aggregate of 20,000 ft. of track was washed out at various points, and 1,900 ft. was covered by slides or washed-in boulders to a depth of 20 ft. or more, while debris from 3 to 5 ft. deep covered the track at numerous other points, ranging from a few hundred feet to one-half mile in distance. The Mojave river, ordinarily an inconsequential stream which loses itself in the desert a short distance below Barstow, became a raging torrent that stripped all loose material to the underlying rock at Victorville and Helendale, where the gorge through which it flows narrows, leaving 3,800 ft. of track on the verge of a channel varying in depth from 18 to 40 ft.

Damage on the Pasadena lines, which is on relatively high ground, was much lighter, although there were 18 washouts aggregating 1½ miles, including several bridges partially washed out. In San Bernardino both main tracks were washed out for approximately one mile east of the station and the precooling plant was blocked by debris. Between San Bernardino and Atwood, 42 miles, there were 18 washouts, with slight damage to several bridges, while in one case the track was washed completely off the right of way.

At Prado, about 4 miles west of Corona, the Fullerton line enters the canyon of the Santa Ana river, which it occupies for about 8 miles. The volume of flood water in this stream and the narrow canyon combined to produce a remarkable velocity of flow and, although the track was above high water and well protected against ordinary floods, four major

washouts occurred. After emerging from the canyon the river spread over a wide area, washing out almost 3 miles of track between Fullerton and Anaheim.

In the first 4 miles out of Barstow, on the line to San Francisco, there were nine washouts aggregating 1,233 ft., but these were less serious and the line was restored quickly, so that there was little interruption to the San Francisco service. The remainder of the damage on the Santa Fe occurred either on branch lines or in yards.

Although the rain had been unusually heavy for four days, the first break occurred unexpectedly on the morning of March 2, but even before the extent of the damage became apparent, the officers of the Santa Fe began to assemble men and equipment to start the restoration of its lines. To provide an organization quickly, they closed the shops at Los Angeles and the large shop at San Bernardino, using the shop forces as a temporary expedient to augment the regular maintenance forces. Fortunately, sufficient men seeking employment were available and as soon as the work began to be organized these men were hired and the shop men were returned to their regular duties. In addition to the regular and temporary forces, experienced gangs, mostly of bridge men, were sent in from other divisions.

Supervision of these suddenly increased forces was provided by engineering and operating officers and section foremen on the ground, as well as by others brought in from adjacent districts. Since communications were disrupted and the highways were impassable, it became necessary for these men to penetrate into the damaged territory on foot, to ascertain the extent of the disaster and in what way restoration could be accomplished most quickly.

Damage on the Santa Fe Was Most Severe North of San Bernardino and Along the Santa Ana River. Arrows Indicate Places Where Major Damage Occurred.

Power Machines Utilized

It was quickly apparent that power machines would be of equal, if not greater, importance than man power in the restoration of the washed-out roadbed and the removal of the large quantity of debris that covered many sections of the line between Barstow and San Bernardino. Yet the difficulties of getting these machines to the places where they could be used to advantage seemed insurmountable, since trains could not get through and the highways were still impassable.

However, all of the maintenance equipment owned by the Santa Fe in the affected area was mobilized at once and assigned to the points where it could be used to best advantage. A train load of bridge timbers and hardware was shipped from the treating plant at Albuquerque, N. M., and this, together with two pile drivers and two ditchers, was moved by special train to Barstow, in charge of such engineering officers as could be spared and with three bridge gangs.

Tractors equipped with bulldozers, power shovels, draglines, ditchers and cranes with clamshells and pile leads, all on crawler-mounting, were rented wherever possible and were worked night and day. This equipment was loaded on flat cars and taken as far as trains could go. The various units were then started across the fields or down the still impassable highways to reach their assignments. The tractors proved to be particularly effective in repairing the damage done by side washes and in removing the lighter accumulations of debris from the tracks. The power shovels and draglines were used to remove the larger accumulations of debris which in several instances had piled up to the depths of 20 ft. for distances of 500 to 750 ft. This equipment was also used to advantage in the construction of shoo-flies around bad holes, and the pile drivers were in constant service, replacing bents which had been washed out.

In the canyon of the Santa Ana river, the current remained so swift that no material that was available for restoring the embankment could be held. For this reason, air compressors and rock drills were sent in to drill and blast the rock from the canyon walls above the roadbed. When this had been brought down in sufficient quantity, it was leveled off to form the roadbed and the track was restored.

Ballast was obtained from quarries and gravel pits, while sand-bag protection was provided against further side wash at points where the strong currents continued to prevail, while much dike and crib work was constructed. As an emergency measure, 500 jetties were purchased and erected to give protection to the new fills along Cajon creek in Cajon pass between Cajon and Devore.

During the period of rehabilitation the work was seriously hampered by the almost continuous rainfall that succeeded the more severe storm that ended on March 4. In fact, after the line was restored on March 10, a further heavy rainfall occurred that night, again raising Cajon creek to flood proportions and causing further damage along the new fills between Cajon and Devore. This latter damage was repaired quickly, however, and train service was again resumed by mid-afternoon on March 11.

Despite the extent of the damage suffered and in the face of the many difficulties encountered in the way of continuous rains after the worst of the storm was over, the impassable roads and the early lack of communications, the line through Cajon pass and the Pasadena line between San Bernardino and Los Angeles were opened on March 10. The Los Angeles-San Diego line was opened on March 9, and the low-grade line through Riverside and Corona was placed in service on March 17.

A Careful Field Inspection Should Be a Part of Every Rail Renewal Program

How Prolong the

In This Paper, the Author of Rail Conservation and

SINCE new rail comprises only a small percentage of the total rail in track, primary consideration in any discussion of rail conservation should be given to the problem of increasing the service life of rail that has been in the track for some time and which has been subject to some wear and deterioration. I shall, therefore, discuss first some of the aspects of this broad phase of the general problem of rail conservation, after which attention will be given to the matter of new rail.

When Is Rail Worn Out?

Let us consider first the question: When is rail in such condition as to require renewal? Practically all maintenance officers will accept as much new rail for immediate installation as they can get. Moreover, much rail which was represented as being urgently in need of renewal five or more years ago, is still in service and carrying faster trains than ever before. It is not my intention to argue against the installation of new rail but I am inclined to believe that the capacity of rail steel to absorb additional wear has often been underestimated.

For instance, it may be contended that rail is so badly "surface bent" that it is beyond correction, but this is a much-abused term which is used to designate a condition that does not exist. Rail may be considered too thin for safety; it may look like it had flowed too much and is, therefore, useless. Or, in addition to containing these defects, it may be corrugated and burned and, therefore, must be removed. But the rattle of the buffers, face plates and draft gears is far less pleasant to me than the imperfections mentioned.

Driver-Burned Rails

Rail burns may occasionally have serious implications, but not as a general rule. Moreover, this troublesome condition is perennial at certain locations, such as turnouts, signals, water cranes, and stations, where the locomotives of long trains stop, and any new rail installed at such places is likely to be burned the day following its installation. Our only recourse in this situation is to appeal to the operating department to the end that locomotives will be handled in such a manner as to avoid spinning the drivers. So far such appeals have been of but little avail in correcting the situation.

The building up of driver-burned spots in rails by electric arc or gas welding has been advocated, but, in my opinion, this is a dangerous practice. It is true that thousands of rail ends are built up with a fair degree of success, but the application of metal in the body of the rail sets up high internal stresses, and the quick chilling of the metal produces a border structure that is highly susceptible of fracture. Such welds, of which there might be three or four or even more in one rail, are potential fractures of the type that could occur suddenly. In my opinion the welding of burned spots on rails is a practice that should not, in the interest of safety, be tolerated.

Corrugations comprise another troublesome problem that has not yet been solved. No one has yet been able to lay his finger directly on the cause of rail corrugations. An answer is no sooner presented than new developments prove it to be incorrect. Corrugations, which are generally 0.004 to 0.006 in. in depth are, of course, not dangerous and it would be difficult to show whether they have any direct effect on maintenance or its cost.

Various attempts have been made to remove corrugations by grinding, and the best device for this purpose that I have seen is the grinder or "scrubber" car† of the Lehigh Valley. This car carries a series of carborundum bricks that are brought into contact with the rails as the car moves along. When in operation the car moves at a speed of about 20 miles an hour, and anywhere between 5 and 15 trips must be made over the rail before the peaks of the corrugations are ground down satisfactorily. Even then they may not disappear entirely and the pattern may still be recognized. After they have been ground down it is significant that, instead of reappearing, the corrugations gradually blend into each other so that a smooth running surface is re-established. The cost of operating this machine is about $20 per mile.

Welding a Live Subject

Considerations entering into the building up of battered rail ends comprise probably the livest subject to be dealt with in any discussion of rail conservation. Rail-end batter is probably the most important factor leading to the necessity for renewing rail, and in an effort to prolong the life of rails damaged by this defect many railroads have adopted as regular practice the building up of battered rail ends by either the oxy-acetylene or the electric-arc process.

In my opinion, such welding has

*Abstracted from a paper presented before the Metropolitan Track Supervisors' Club, New York.

†For a detailed description of this car see *Railway Engineering and Maintenance*, for September, 1934, page 472.

Life of Rails?*

Discusses Current Methods Improved Rail Manufacture

The "Scrubber" Car Employed on the Lehigh Valley for Removing Rail Corrugations

By C. B. BRONSON
Inspecting Engineer, New York Central

been overdone in some instances. This sometimes happens when welders are assigned to given territories and are allowed to build up rail ends before such action becomes necessary, or to reweld rail ends in a relatively short time after the first application. Moreover, I have encountered instances in which one division of a road has accounted for as much as 75 per cent of all rail end work done on that road, the implication being that someone on that division was partial to rail end welding to the extent that it was allowed to be carried beyond actual needs. It is inconceivable that all bad joints should occur on one or two divisions.

The fact cannot be overlooked that welding is a casting proposition and that metal applied in this manner is not of the same degree of excellence as the parent metal. In my opinion much welding can be avoided by grinding abutting rail ends to correct the surface relationship between them. It is not my intention to advocate that welding be shunned entirely but simply that it be used with discretion.

Departures in Rail Manufacture

Much progress has been made in developing means of prolonging the life of new rail. In this movement the steel mills have been an important factor. The metallurgical departments of the mills are continually assuming more responsibility for the quality of the steel produced and maintain a constant surveillance of the various processes by means of representatives, who are stationed everywhere about the plants. These representatives are vested with authority to reject any product at any point in the process which in their judgment does not measure up to the desired standard. Thus an effective check is maintained on the operating department, whose chief aim is to maintain the rate of production.

The steel mills have also been active in developing new processes and because of this work the metallurgical laboratories at some plants are veritable beehives of activity. This development is largely a result of what is rapidly becoming an almost universal demand on the part of railroads for the heat control of rails in production, and also because of the growing practice of many roads of specifying that rails be end-hardened at the mill.

Controlled Cooling

To many the term "controlled cooling" is somewhat mysterious, but in reality the principle involved is quite simple. When rails are cooled rapidly through the range between 500 deg. and 600 deg. F., which is known as the brittle range, the metal in the interior of the head is likely to be shattered or torn apart. Not all rails are susceptible to this effect, and it is not definitely known why some rails are or what the inducing causes might be, whether chemical, structural or physical. However, it has been discovered that, if newly-rolled rails with a temperature of 800 deg. to 1,000 deg. F. are covered so that the rate of cooling is slowed down, the shattering could be eliminated. While simple, this process is effective, and, since it is definitely known that shattering is a major factor in the formation of fissures, controlled cooling holds promise of doing much to alleviate the severity of the troublesome fissure problem.

Brunorizing

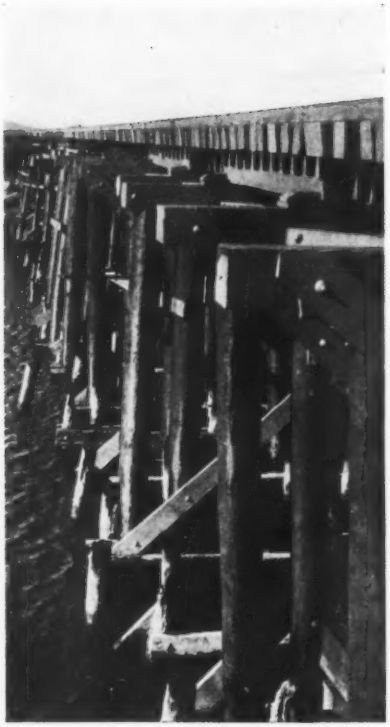
The United States Steel Corporation, by means of its so-called normalizing or Brunorizing process, has attacked the problem in a somewhat different manner. The purpose of this process is two-fold. First, by equalizing the temperature in the rail the stresses set up during the rolling process are eliminated, thus placing the steel in position to avoid shattering in the interior of the head of the rail. Secondly, the temperature of 1,525 deg. F. to which the rails are heated is sufficiently high to bring about a refinement in the grain of the metal. The hardness of the rails is not materially affected in either the normalizing or controlled cooling processes.

It should be borne in mind that controlled cooling and normalizing are not considered cure-alls for every type of rail failure. While they will have an important influence in the elimination of fissures and, possibly, horizontal split heads, they will have little effect on other types of failures, such as common vertical split heads, split webs, bolt-hole fractures and base breaks.

The end-hardening of rails is another important development in the

(*Continued on page 322*)

Meeting the Test at



Two-Hundred 70-ft. Creosoted Piles Were Driven in the Replacement Work

LAST spring, the bridge and building forces of the New Haven were called upon suddenly to rebuild approximately 250 ft. of double-track, main-line pile trestle that had been destroyed by fire. Before the fire was completely extinguished, several bridge gangs were on the scene, and within 109 hr., materials had been ordered, delivered, framed and erected to permit single-track operation to be resumed. Four days later, full double-track service was established on the rebuilt structure.

An Achievement

This achievement, which was imperative in view of the volume and character of the traffic affected and the cost and inconvenience of detouring this traffic, was made possible by closely co-ordinated activities of several departments of the road; the mobility and skill of the road's bridge and building forces; and the ready availability of power tools and equipment with which to carry out the work with the greatest speed and the highest class of workmanship. In one respect, the speed with which the work was done was affected favorably by the availability for prompt delivery from a neighboring road, of two hundred 70-ft. treated piles required in the replacement work.

The burn-out occurred on the Lieutenant River bridge, on the New Haven's double-track Shore Line Route between New York and Boston, Mass., about 1700 ft. east of its large bridge over the Connecticut river near Saybrook, Conn. The structure involved, which was one of four remaining timber bridges on this main line, consisted of two sections of double-track pile trestle, one about 165 ft. long at the east end, and the other about 82 ft. long at the west end, joined by a 19½-ft. steel deck girder span with an open-type deck.

The trestle sections had yellow pine pile bents of 12 piles each, with most of the piles 70 ft. in length. All caps and stringers were of yellow pine, and the bridge ties were largely fir. All of the caps, stringers and ties were treated, while only approximately 30 per cent of the piles were treated. The treatment in each case was with creosote distillate, applied by the full-cell process, with a retention of 8 to 12 lb. per cu. ft. The ties over the bridge were approximately three years old, while the service age of the stringers, caps and piles ranged from 2 years to 10 or 12 years. The steel span consisted of shallow deck girders with an open deck, thus making the deck continuous over the structure as a whole. The usual water barrels were provided at the ends of the bridge, but the deck itself had no fire-resistive coating or metal covering.

At approximately 9:50 a.m. on May 17, the structure caught fire and, in spite of efforts to extinguish the blaze, the 165-ft. trestle section at the east end was damaged so seriously that it required complete renewal. At the same time, the ties and guard timbers on the steel span were destroyed, together with practically everything above the pile caps of the trestle section at the west end, and many of the caps and piles in this section.

Rapid, Stubborn Fire

The fire, of undetermined origin, was discovered by a welding gang foreman, who, with his gang, was engaged at the time in building up rail ends approximately 1,000 ft. west of the bridge. Noticing smoke rising from the track in the vicinity of the bridge, the foreman hurried to the structure on foot. Here, he found the deck afire on the south side near the east end, and spreading rapidly, aided by a generally prevailing south wind. The rapidity with which the fire spread is indicated by the fact that while the foreman was able to cross the burning section to the east bulkhead and to return promptly, it was only a matter of minutes before the entire width of the deck was covered with an impassable wall of flames, making further recrossing impossible. Progressing westward, the fire reached the steel span and then spread from tie to tie until it reached and spread through the trestle section at the west end.

Early Alarm Sent

Within a few minutes after the blaze was discovered, telephone alarms had been sent to the local volunteer fire departments of the two closest towns, and the men from the welding force began an attempt to extinguish the fire with water from the water barrels at the west end of the structure, which were the only ones that could be reached. This effort, and that of the local fire departments with their limited equipment for fighting such fires, made little impression upon the blaze, and it was only when a small water craft with a pump and a hose line was able to direct a stream against the underside of the deck with some effectiveness, that the intensity of the fire was checked on the west-end trestle section, and that the fire was finally extinguished after a period of approximately six hours. No part of the deck structure fell as a result of the fire, for even the part that was most severely burned continued to be held together on the deeply charred piles by the bridge spikes and bolts, and the badly buckled track rails.

Promptly following the discovery of the fire, the headquarters of all affected departments, at New Haven, were notified by telephone, and arrangements were immediately set up to detour all traffic. Freight trains were moved over other lines of the road, leaving the Shore route at New Haven, 35 miles west of the bridge,

t a Bridge Burn-Out

Last spring, the bridge and building forces of the New York, New Haven & Hartford were put to a real test in rebuilding a main-line bridge involving approximately 250 ft. of treated pile trestle destroyed by fire. Stimulated by the importance of the structure and the costs and delays of detouring traffic, and aided by a full complement of power tools and equipment, single-track operation over the bridge was restored in 109 hr., and both tracks were back in full service on the eighth day following the fire. The extent of the work and the manner in which it was organized and carried out are described herein.

and at Providence, R. I., about 78 miles east of the bridge. Through passenger trains were routed over the Boston & Albany, from Springfield, Mass., to Boston. With 17 important passenger trains and 14 or more manifest freights scheduled eastbound and westbound daily over the Shore route the detour problem was a serious one, both because of the added expense involved and because of the longer routings necessary, largely over secondary lines. However, in its secondary lines and connections for rerouting the road was fortunate, and was able to keep all trains moving with relatively little delay.

As detour arrangements were being set up, the wheels were set in motion to gather men, equipment and materials to make such repairs as would be necessary. Even before the fire was fully extinguished, two division bridge and building gangs were on the scene, and the chief maintenance officer and the assistant engineer of structures of the road had made a careful check in the field of the extent of the damage and had given the chief engineer at headquarters, by telephone, a list of the materials required for making repairs. Shortly thereafter, calls went out to the different divisions for men and materials, and, where necessary, outside sources were contacted for materials. Altogether, the timber requirements called for two hundred 70-ft. piles; three hundred 10-in. by 10-in. by 10-ft. bridge ties; 800 lin. ft. of 5-in. by 8-in. guard timbers; sixty 12-in. by 14-in. by 18-ft. caps; and two hundred 8-in. by 16-in. stringers 24 and 26 ft. long.

The 70-ft. piles were the only real cause for concern since there were few piles of this length available on the road. However, it was found that the Boston & Albany had available at Westboro, Mass., approximately 95 miles away, practically all of the treated 70-ft. piles required, which it was willing to release, and loading was started at once.

The first evening following the fire, there was little that could be done on the structure except to start stripping the deck and to continue organizing for the work, but by 6 o'clock the following morning, cranes with pile-driver leads and the first shipment of the long piles were spotted at each end of the bridge. By noon, more material

Above—The Entire East Side of the Structure Was so Badly Damaged that it Had to Be Completely Rebuilt. Left—The Most Effective Fire Fighting Was Done from a Boat.

was at hand, together with ample track forces, and a total of 14 division bridge gangs with a combined force of 102 bridge carpenters were either on the job or on their way. With the exception of the two bridge gangs from Boston and Providence, which came by train, all of the track and bridge forces came in their gang motor trucks and brought with them all of the tools and portable equipment necessary to their operations.

Progress Rapid

Under the direction of the chief engineering and maintenance officers of the road, who established headquarters near the work, the forces were carefully organized into two 12-hour shifts, and the work progressed rapidly and with a high degree of co-ordination. While certain of the gangs undertook the progressive dismantling of the burned structure, other bridge gangs, working from both ends simultaneously to restore service on the eastbound track first, prepared the piles for driving, drove the piles, framed and set up the stringers, and moved the material up as required. One by one the new piles were driven, and by early afternoon of the first day after the fire, one pile bent had been completed and a second started.

Traffic Restored in 108½ Hr.

Pushing forward with increased speed as the operations became more routine, the eastbound side of the bridge was completely rebuilt and restored to service at 10:15 p.m. on May 21, 108½ hr. after the discovery of the fire. Immediately, all detouring of trains was stopped, and all passenger and freight trains moving on the Shore route, in both directions, were single-tracked over that part of the bridge that had been rebuilt. Work was then begun on the rebuilding of the westbound side of the bridge, and, in spite of the delays and inconveniences resulting from the frequent movement of trains over the eastbound track, this was completed at 6:25 p.m. on May 25, the eighth day after the fire.

Within 109 Hr. After the Fire, Single-Track Operation Was Resumed, and Four Days Later the Rebuilt Structure Was Put in Full Service

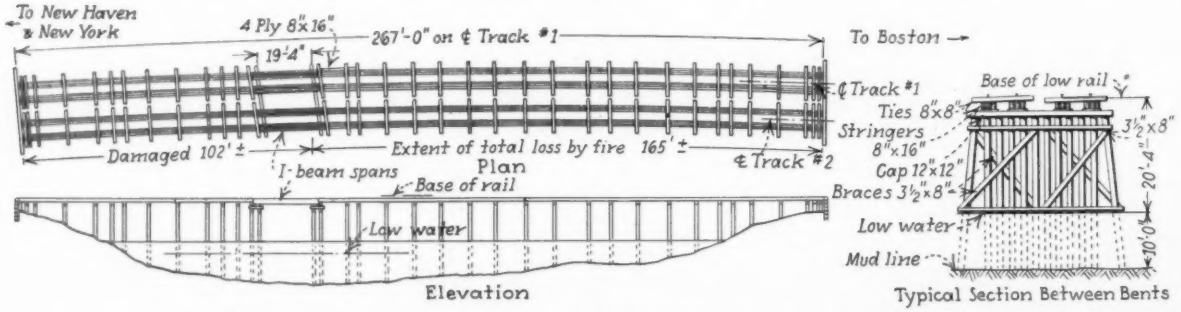
Subsequently, such finishing operations as were necessary were completed, and the exposed surfaces of all of the untreated deck timbers, including the ties, were given a coating of fire-resistive paint. The entire expense involved in rebuilding the bridge was approximately $47,000, which does not include revenue losses and the cost of detouring trains.

In addition to the circumstances already mentioned, several other factors contributed to the speed with which the work was carried out. Possibly the most important of these was the availability of an adequate supply of suitable power tools and equipment to speed up the various operations. In the first place, four steam cranes, two with pile driver leads and two with 50-ft. booms, were in condition for immediate service and movement to the work. In the second place, with every division bridge gang equipped with portable electric generating sets, portable power-operated pumps, and power saws and drills, there was no lack for any of these units on the job, and no delay in their arrival, since each motorized gang brought its own equipment in its own motor truck. As a matter of fact, there were 12 portable gasoline-driven electric generating units at the site of the work, each equipped with a power saw and drills of various lengths, which were used in the dismantling of the destroyed structure and the framing of all of the new timber. There was little use for the portable electrically-operated pumps, except as two units were employed effectively for periodically replenishing the reservoir supplies of the steam cranes, precluding any delays in this regard.

Work Well Lighted

Another factor which had an important bearing upon the progress of the work was the adequate artificial illumination which was afforded for night operations. In this, a nearby commercial power line was first tapped, and a temporary line, with 100-watt lamps at intervals, was strung across the bridge on posts spiked to the deck timbers and moved about as conditions required. Almost at once, however, it became evident that a supplemental source of electric current supply was necessary to provide sufficient light for carrying out the intensive and scattered operations with safety, so two portable generating units, normally used in electric tie-tamper operation, were loaded into bridge and building department highway trucks and brought quickly to the job. If these additional units had been inadequate, other similar units were available for ready transport to

(*Continued on page 322*)



Sketch Plan, Elevation and Typical Section Between Bents of the Lieutenant River Bridge, Showing the Extent of the Damage by Fire

Each Man Speaks His Mind Freely at the Periodic Informal Meetings of the Boston & Maine Track Supervisors' Association

Getting Down to Details on the B. & M.

For more than 20 years, the track and bridge and building supervisors on the Boston & Maine, in separate organizations, have been holding periodic system meetings under their own initiative and auspices, to discuss their every-day railroad problems. Unrestrained or unrestricted in their deliberations by official influence, these organizations, whose activities are described in this article, get down to the bare facts in their discussions and thereby quickly crystallize the opinions of the men in the field.

FOR more than 20 years, the Boston & Maine has encouraged periodic system meetings of its track and bridge and building supervisors as a melting pot for their thoughts and ideas. During the last six years, the meetings of the track supervisors have taken on an organized form, and this group, including 20 members, with elected officers, is now known as the Boston & Maine Track Supervisors' Association. The meetings of the bridge and building supervisors, which are confined largely to the four men of this rank now on the road, are more informal than those of the track supervisors, as might be expected in view of the smaller number of men involved, and yet, the bridge and building supervisors, like the track supervisors, have largely pre-arranged programs for discussion at their meetings, and issue minutes for the benefit of those interested or concerned.

Provide Forums

The fundamental purpose behind the supervisors' meetings, which are conducted without the presence of any higher supervisory officer other than the usual informal attendance of a representative of the engineer maintenance of way, is to afford the supervisors with forums for the unrestricted discussion of their every-day problems in the interest of their departments and of the railway as a whole. In addition to the value that has accrued in this regard, however, it has been found that the meetings are a prolific source of new ideas, promote a high degree of good will toward the road, and provide a means for the crystallization of thought on a wide range of subjects relative to improved equipment and methods of performing work.

Meetings Are Voluntary

The meetings of the Boston & Maine Track Supervisors' Association are, in a sense, comparable to the periodic division track supervisors' meetings held on many roads, but the detailed organization and programs of the association make it more nearly comparable to the Roadmaster's and Maintenance of Way Association of America, with the added advantage of more frequent meetings. Throughout their early years, the meetings of the track supervisors were little more than informal group discussions of current problems, which, while of value, seemed to offer much opportunity for improvement in organization and scope. Therefore, in 1929, the men, acting on their own initiative, but with the approval of the management, developed their present organization. This organization, whose membership is confined to supervisors of track and their assistants, has a president, who presides over the meetings, a vice-president, and a secretary. The organization is voluntary in every respect and entails no dues or other obligations, except a general demeanor creditable at all times to the association, its members, and to the railroad. Aside from one social function during the year, a summer outing at a New England resort, the activities of the association are confined strictly to business, this taking the form of the periodic meetings, the preparation of papers for discussion at the meetings, and such field studies as are authorized to be made.

The frequency of the meetings has varied, although for many years there was an earnest effort to schedule a meeting each month. With the enlarged responsibilities placed upon the men during the recent years of de-

pressed business conditions, the number of meetings has been reduced to six a year, held usually about the middle of alternate months, unless adjusted as to time because of special conditions. These conditions have usually been confined to special summer work schedules or to severe winter conditions or emergencies, although the date of one of the meetings has usually been adjusted to coincide with the annual dinner of the New England Railroad Club, so that the men can attend this meeting as well as their own.

Four-Hour Sessions

The meetings of the association are held in the Terminal Division office building, at Boston, Mass., where a room of adequate size is available. They start at 10 a.m., and except for a luncheon period of about one hour, continue usually until about 3 p.m., when a number of the men must leave on trains to get back to their headquarters at a reasonable hour the same night. In only a few cases are the men more than three or four hours distant from their territories, the longest trip being from Mechanicsville, N. Y., approximately 200 miles. All expenses of the men while away from their headquarters are paid by the railroad.

In spite of the increased responsibilities placed upon the supervisors in recent years, they have continued so interested in the work of the association that it is only infrequently that they do not so arrange their work that they can attend its meetings. Thus, in spite of its entirely voluntary character, there is usually 100 per cent representation at the meetings, with frequently one or more assistant supervisors in attendance. While the supervisors are away from their territories, routine matters are generally left with their foremen, whose work has been lined up for them in advance. If unforeseen emergencies should arise, the foremen can always reach their supervisor's office for help or instructions.

Visitors Sometimes

As already indicated, the meetings are strictly supervisors' meetings, unrestricted in scope or character of discussion by the presence or influence of higher supervisory officers. Frequently, division engineers, the supervisor of work equipment, bridge and building department representatives, or other supervisory officers are invited to the meetings when comments are desired from them on any particular subject, and, on occasions, manufacturers' representatives have been invited where details concerning specific devices or products have been desired. Otherwise, the only nonmember who is authorized to attend the meetings without invitation is the engineer of track, who sits in as the representative of the engineer maintenance of way, largely to answer any questions directed at him.

A visitor who is always welcome at the meetings, and almost invariably in attendance, is the system or district safety department representative. As a matter of fact, a part of the time at each meeting is set aside for a discussion of safety practices and records, particularly as they affect the track forces. Thus, while specific information on any subject can be brought into the meetings as desired by the members, an attitude of unrestraint and frankness prevails in which constructive criticism of present standards or practices is as welcome as discussions of new methods, types of equipment, or gang organizations.

Definite Programs

The programs of the meetings are built around groups of specific questions or subjects suggested by the men themselves out of their daily experiences. Stimulated by a Subjects committee, the men keep passing subjects to the secretary for consideration, and at least two weeks prior to a meeting, each supervisor is advised of the date of the meeting and of the subjects to be discussed. Many of the subjects considered are not entirely new, and, in fact, may have already been passed upon by the engineer maintenance of way and made the matter of definite instructions to the division engineers, and through them to the supervisors. Thus, it is evident that no restriction is placed by either the engineer maintenance of way or the division engineers upon the discussion of any subject or matter which the supervisors desire to take up.

The originators of specific subjects are generally expected to introduce them at the meetings, outlining any considerations which may have prompted the subjects and expressing their own thoughts concerning them. Beyond this initial presentation of subjects, which may be in the form of written papers, the discussions, under the guidance of the president, are strictly informal. An indication of the diversified character of the subjects which have been brought before the meetings is gained from the following list of typical subjects which have been given consideration:

What is the most desirable grade of oil or rust inhibitor for oiling switch points and slide plates?

Should repaired switch stands be used on main line switches?

Can motor car operators comply fully at all times with recent instructions requiring the pushing of single-cylinder motor cars, in view of the possibility of snow, ice or frost on the rail during the winter months?

Where high shimming is necessary, should gage rods be used to reduce the number of braces required, and thereby prevent damaging the ties? What relation should there be between the number of gage rods used and the height of the track shimming?

What is the best method of reducing the wear on switch points in yards and side tracks?

Should the present type of standard clay pick be continued, or could it be altered in design to be more effective?

What is the best method to employ in properly lining switch points, and what is the best method of field-punching No. 3, 4 and 5 switch rods for 30-ft. switches?

Should hyrdo-carbon oil or other snow-melting oil, remaining in drums on stands after the winter, be allowed to remain in the drums during the summer, or should such oil be placed in storage under cover? Why?

Should gage rods be furnished with forged or hook ends?

Should a section motor car lighter than the present type be furnished section crews with five men or less?

Should bolts or rivets be used in spring frogs for securing base plates to the rails?

Is it advisable to provide gages for section foremen who have a number of flange frogs in their yards, so that they can test the wear of these frogs to determine when they should be renewed?

What is the best practice when cutting rail with a chisel?

What are the most desirable features to be incorporated in section or motor car houses?

Should spikes be driven down tight to the rail, or should they be allowed to remain a little high in order to permit wave action and natural expansion and contraction in the rail?

Where rail is tight, what practical measures can be taken to open up and adjust expansion gaps uniformly?

Should the rail from tangent track be relaid with the original gage side in or out? Why?

What is the best method of shimming track?

Should a book of standard plans, containing only such plans as cover trackwork, and with cheap binding, be furnished to track foremen?

What is the most desirable size of switch targets and banners?

Definite Action Taken

Frequently, the discussions of specific subjects are extended over several meetings, as may be required, to bring out all of the important facts, this being required on occasions to permit the accumulation of pertinent data from special sources, and, at times, to permit the making of field investigations. The action taken at the meetings is made a matter of record by the secretary, who sends this information to all of the members in the form of typewritten minutes. Copies of the minutes are also sent

to the engineer maintenance of way of the road, frequently with notations calling attention to matters of specific interest, or suggesting action on matters beyond the scope of authority of the supervisors. These matters are always given the most careful consideration by the engineer maintenance of way and his immediate staff, and, not infrequently, are discussed and passed upon at the periodic meetings of the division engineers with the engineer maintenance of way. Not infrequently also, the subjects raised have led to special investigations by the system and division engineers to determine what final action or policy should be decided upon. In all cases, the engineer maintenance of way makes specific reply to the supervisors' association concerning all definite recommendations, either approving or disapproving them. When a recommendation is not approved by the engineer maintenance of way, definite reasons are always given.

B. & B. Meetings

What has been said concerning the association of the track supervisors and its activities applies equally to the periodic meetings of the bridge and building supervisors on the road, with the single exception that the latter group, which includes only four men at the present time, is, because of its small size, less formal in its organization. However, this group has a secretary, who sends out notices of the meetings, arranges the programs for discussion, and issues minutes of the action taken. As with the track supervisors' meetings, copies of the minutes are sent to the engineer maintenance of way, where they are given careful consideration by him and his immediate assistants particularly interested in bridge and building department matters.

Of Distinct Value

That the activities of the two supervisors' groups have been of distinct value to the railroad and to the men themselves has long been accepted on the Boston & Maine. Year after year the meetings have been a clearing house for the best ideas of the men, and out of them have come many improvements in standards and practices, with resulting increased safety, efficiency and economy. At the same time, the meetings have been a means of creating the highest Esprit de corps among the supervisors, and of stimulating the rapid, intelligent adoption of uniform best maintenance practices over the entire road.

Rail Production Hit Seven-Year Peak in 1937

STIMULATED by the recovery of business during the latter part of 1936 and the early part of 1937, and the prospects of continued recovery throughout 1937, the production of rails in the United States in that year, according to statistics compiled by the American Iron & Steel Institute, was the highest since 1930, reaching a total of 1,445,739 gross tons. This production, while 428,494 tons lower than in 1930, was 1,043,173 gross tons greater than in 1932, the low point of production during the depression and, in fact, since the early days of the railway industry, and was 225,893 tons greater than the production in 1936, 1,219,846 tons, which, itself, was a six-year high.

In all of the weight classifications in 1937, the tonnages exceeded those of 1936. In the heaviest sections, including those weighing 136 lb. and over, production increased from 22,680 tons in 1936 to 31,238 tons in 1937, or 37.7 per cent, representing a distinct reverse in the trend from 1935 to 1936, when the production in these larger sections decreased 36,178 tons, or 61.4 per cent. In the weight group including sections from 120 lb. to 136 lb., production continued to increase, amounting to 389,909 tons in 1937 as compared with 368,470 tons in 1936, an increase of approximately 6 per cent, while in the group embracing sections from 100 lb. to those weighing less than 120 lb., the increased production was from 611,527 tons to 727,929 tons, an increase of approximately 19 per cent.

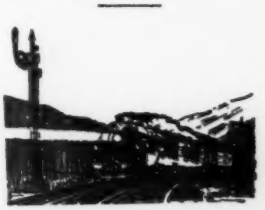
In the lighter sections, including 85-lb. rails and those weighing less than 100 lb., production increased from 99,961 tons in 1936 to 112,638 tons in 1937, or 12.7 per cent, while production in the "50-lb. and less than 85-lb." group showed the surprising increase from 21,097 tons to 82,338 tons, or 290 per cent, which represented the first appreciable production of these lighter sections since 1931, when only 25,524 tons were rolled.

As usual, the bulk of the rails produced in 1937 was from open-hearth steel, the tonnage in this classification amounting to 1,411,655, or 97.64 per cent of the total production. The production of rails from Bessemer and electric steel amounted to only 625 tons, and all of the rails produced from these steels were in weights of 60 lb. or less. In addition to the rails rolled from new steel in 1937, the total production of 1,445,739 tons included 33,459 tons of rails rolled from old rails; 39,119 tons of girder and high tee rails; and 757 tons of alloy steel rails, the last mentioned representing an increased production of 309 tons over the quantity of alloy rails rolled in 1936.

Production of Rails by Weight Per Yard

Years	Under 50 lb.	50 and less than 85 lb.	85 and less than 100 lb.	100 and less than 120 lb.	120 and less than 136 lb.	136 lb. and over	Total
1920	489,043	433,333	952,622		729,118		2,604,116
1921	211,568	214,936	902,748		849,566		2,178,818
1922	265,541	274,731	728,604		902,900		2,171,776
1923	272,794	300,907	864,965		1,465,850		2,904,516
1924	191,046	213,274	853,431		1,175,581		2,433,332
1925	163,607	219,648	765,371		1,636,631		2,785,257
1926	197,260	256,287	797,662		1,966,440		3,217,649
1927	161,836	173,257	539,445	1,314,424	617,524		2,806,486
1928	134,197	125,726	465,393	1,203,749	718,428		2,647,493
1929	141,362	102,944	409,628	1,233,599	834,605		2,722,138
1930	95,626	81,299	267,879	835,496	592,933		1,873,233
1931	50,089	25,524	123,398	495,752	462,988		1,157,751
1932	16,655	13,705	28,593	215,091	128,522		402,566
1933	*49,116	†15,413	40,973	154,007	156,787		416,296
1934	*70,085	†17,111	73,639	491,642	325,942	31,805	1,010,224
1935	*57,127	†14,758	85,627	340,800	154,367	58,858	711,537
1936	*96,111	†21,097	99,961	611,527	368,470	22,680	1,219,846
1937	*101,687	†82,338	112,638	727,929	389,909	31,238	1,445,739

*60 lb. or less per yard. †Over 60 and less than 85 lb. per yard.



Passenger Station Moved on Flat Cars

WHEN the Canadian Pacific was confronted recently with the task of removing a frame passenger station of sizeable dimensions to a new location 44.5 miles away it hit on the expedient of transporting the structure bodily on flat cars. The building, which was originally located at Loyalist, Alta., on a branch line, is one and one-half stories in height, has a freight shed attached and is 90 ft. by 24 ft. in plan. This station had not been in use for some time, and when the station at Castor, Alta., on the same branch line, was destroyed by fire recently its replacement with the idle structure at Loyalist was decided upon.

A Railway Station Takes to the Rails

In preparation for its removal, the chimney and window frames of the station were removed and the building was cut into two sections so that the parts could be handled on 46-ft. flat cars, after which the structure was jacked up to an elevation somewhat above car-floor level and supported at that elevation by cribbing. A temporary spur track was then laid under the raised structure and cut into the main track, after which flat cars were spotted in the proper positions under the two sections of the station and the latter lowered into position on them.

Preparations necessitated along the route of movement consisted of the dismantling of switch stands, track signs, train-order boards and other obstructions, the raising or cutting of a number of wire crossings, and the throwing over of the main track at a water tank. At Castor preliminary work included the construction of the foundation for the station and the laying of a temporary spur track to the rear of the foundation. When the flat cars carrying the station arrived at Castor they were spotted on the temporary track, the two sections of the station were cribbed up to permit removal of the cars and, using jacks, the structure was moved downward and sidewise into position on the foundation.

We are indebted for the information contained in this article to F. W. Alexander, engineer maintenance of way of the Western Lines of the Canadian Pacific, under whose supervision the work of transporting the station was carried out.

How Prolong the Life of Rail?

(*Continued from page 315*)

railroad's campaign of rail conservation. End hardening may be applied to either hot or cold rails. When the process is applied to cold rails the portions to be hardened must be brought to a temperature of about 1500 deg. F. to obtain the proper hardness. There is still considerable difference of opinion as to how hard rail ends should be and to what length and depth the rail end should be hardened.

My position in regard to the advisability of hardening rail ends is somewhat neutral. However, there is some question in my mind as to the desirability of subjecting metal of rail-steel grade to a quick heat-treating process, for this is what happens when cold rails are treated. The entire process of heating the rail and quenching it requires about three and one-half to four minutes; this means that the steel must withstand a good deal of punishment.

Moreover, a thorough study of rail-end hardening is being made in connection with the rail investigation which is in progress at the University of Illinois. In the course of this study samples of end-hardened rails from five or six mills have been studied and it has been found that the extent of the hardened metal and also the etch pattern differ widely. In some cases the treated area was found to be very shallow, and in others it was found to extend down into the web. In view of these findings it will be interesting to note the condition of the rail ends after they have been in service five or ten years.

Bridge Burn-Out

(*Continued from page 318*)

the site of the work, or any of the 12 small portable generating units brought with the different bridge gangs could have been used for supplying lighting current when not otherwise employed.

Pullman Sleepers for Men

Still another factor which had a favorable effect upon the progress of the work was the high moral and physical well-being of the men engaged in it, stimulated by the manner in which they were housed and fed. Simultaneously with the calling out of the gangs, one of the maintenance of way department dining cars, used largely in connection with winter snow-fighting operations, was ordered stocked and sent to the burn-out, fully manned to take care of all food requirements of the men engaged in the bridge rebuilding operations. At the same time, rather than disturb the camp car equipment of any of the bridge gangs, three standard Pullman sleeping cars, each in charge of a porter, were sent to the site of the work and were spotted, with the dining car, about 1,000 ft. west of the bridge.

The work of rebuilding the Lieutenant River bridge was planned and carried out under the direction of E. E. Oviatt, chief engineer, and A. L. Bartlett, engineer maintenance of way, assisted by F. J. Pitcher, engineer of structures and design, and J. L. Rippey, assistant engineer of structures; and, in the matter of securing the materials required, by the purchasing department, under the direction of C. E. Smith, vice-president, in charge of purchases.

A Water Station Without Pump House or Pumper

By C. R. Knowles

Superintendent Water Service,
Illinois Central, Chicago

THE Illinois Central has recently completed a water station that has neither a pump house nor a pumper, which is believed to be the first of its kind in railway service. This station is delivering 1,250,000 gal. of water a month through a 100,000-gal. roadside tank. It is located at Crenshaw, Miss., 48 miles south of Memphis, Tenn., on the low-grade freight line of the Yazoo & Mississippi Valley, between Memphis and Jackson, Miss., at which point this freight line connects with the main line of the Illinois Central between Memphis and New Orleans, La.

Although the demand for water at Crenshaw is not large, compared with some other points, it is an important water station because of its location on a busy freight line over which, by reason of its light gradients, heavy tonnage trains are operated regularly. Prior to the construction of the new pumping station, water was obtained from two 10-in. wells, 110 ft. deep.

The old pumping facilities at Crenshaw consisted of a pump house, two 45-hp. vertical boilers and two steam-driven deep-well pumping heads, which operated reciprocating plungers in submerged cylinders. The discharge was into a standard 100,000-gal. service tank. These facilities were installed in 1902, and had about outlived their usefulness when they were retired after 35 year's service.

As power was available at reasonable rates, it was decided to electrify this station. The pumps selected are electrically-driven, automatically-controlled deep-well turbines having weather-proof motors, thus eliminating the necessity for providing shelter in the form of a pump house as well as obviating attendance.

The new installation consists of two 8-in. two-stage deep-well turbine pumps, each driven by a 3-hp. vertical motor. The turbines are connected to the motors by a ⅞-in. vertical line shaft enclosed in a 1¼-in. protective tubing. The discharge pipe, 4 in. in diameter, encloses the line shaft and protective tubing. The pumps are located at a depth of 42 ft. below the ground surface with a 20-ft. 4-in. suction line extending below the turbine impeller bowls. The water is discharged into the 100,000 gal. roadside tank through a 6-in. pipe line with one 90-deg. and two 45-deg. elbows at the base of each pump, which in turn connects with the existing discharge line.

The pumps are exact duplicates and are arranged for alternate operation for 24-hour periods. The automatic control, in addition to maintaining correct tank levels, also without manual operation switches the operation of the pumps so that each pump is in service every alternate day.

The control is by means of switches located at the top of the roadside tank. These switches are operated by individual floats in the tank. One float is adjusted so that one pump starts when the water level in the tank drops 2 ft. below the top. If the first pump fails to start or the demand for water is such that one pump will not take care of it, the second pump cuts in automatically. In the event that both pumps are started, they will continue to operate until the tank is filled, after which alternate operation is resumed.

In addition to these float-controlled switches, automatic switches operate in connection with an electric time clock in such a way that the two float switches, located at different water levels, are changed automatically from one pump to the other at 24-hour periods, so that neither pump is idle more than 24 hours.

The Pump Has a Weather-Proof Housing

The pumps deliver 100 gallons of water per minute against a maximum head of approximately 60 ft. The monthly water consumption is approximately 1,250,000 gal. per month, and the cost of operation, attendance and maintenance has averaged around $17.50 a month, or $210 per annum.

The unusual feature of this installation is the elimination of the pump house, the motors and control panel being located in the open above ground without any housing and protected from trespassers by a fence.

The plant has now been in operation for slightly more than a year without repairs or interruption to service. While this unit is located in the south, sub-freezing temperatures are not unusual, yet no trouble has been experienced from cold weather, rain or snow. The only heat provided in connection with the pumping installation is a small heating element located in the oil cup that provides lubrication for the vertical shaft. The only attendance required in connection with the operation of these pumps is for oiling the motors and filling the oil cups twice a month.

The Pump Is Protected from Trespassers by a Wire Mesh Fence

Details in Use of Tie Adzers

What details should be given attention when using tie adzers? What is the importance of each?

Can Spoil Rail

By J. B. Bragg
Section Foreman, Chesapeake & Ohio, Prince, W. Va.

The most important item in the adzing of ties is a full even bearing for the tie plate in the same plane as that for the opposite rail. If this adjustment of the cutter head is not made, that is, level on tangests and conforming with the superelevation on curves, the wheels will not have an even bearing on the running surface of the rail, causing undue and uneven wear on the rail head. Where this condition exists it is difficult to maintain gage, and, to correct it, considerable hand adzing must be done by the section forces, to the detriment of the ties.

Again, the ballast in the cribs should be lowered about 2½ in. below the top of the tie for some distance on either side of the cut, the ties should be swept clean and all spike stubs driven below the level of the finished cut, before adzing is started. The men operating the machines should be required to wear goggles and leggings.

Adjustment Very Important

By Armstrong Chinn
Chief Engineer, Alton, Chicago

In using any machine, the first thing that should be done is to check it to see that it is in good operating condition and is properly lubricated. It should next be adjusted, if necessary, and put in shape for the particular work that it is to do. If it is an adzing machine, this means particularly that the cutting head must be adjusted so that the center line of the cut will be at the proper distance from the rail from which the machine is being operated, and so that the cut will be exactly level. The head can be adjusted to make a level cut by bringing it down to bear evenly on the face of a new sawed tie, or by checking the first few cuts with a spirit level. These adjustments should be made or checked every time the machine changes sides. Tie adzers are constructed so that adjustments can be made quickly and easily.

When the machine is ready, but before the adzing is started, the ballast should be cribbed out between the ties to a point below the level of the adzing, the ties should be swept clean and spike stubs should be driven down below the level of the cut. This should be followed by the plugging of the spike holes. After the ties are adzed, but before the tie plates are placed, the adzed surfaces of the ties should be brushed with hot creosote.

To insure minimum delay to the adzing operation, a push car equipped with a bit-sharpening machine, a supply of bits and extra cutting heads, in charge of a man capable of sharpening and setting the bits, should follow as closely as practicable behind the battery of adzing machines, so that freshly sharpened cutting heads will be quickly available at all times. Even with guards around the cutting heads, there will be flying particles of ballast and wood around the adzing machines when in operation and of metal around the bit-sharpening tools. For this reason, all men working with or around these machines should be required to wear goggles for the protection of their eyes.

In the order of importance, the foregoing details should be given precedence about as follows:

1. Safety first—see that the men wear goggles.
2. Check the machines to know

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in July

1. What is the best method of distributing ties for renewals in yard tracks? How far in advance of the work should they be unloaded? Why?

2. What advantages, if any, are there in packing ice in ice houses in sawdust? If none, why? What alternatives are practicable?

3. What precautions should be observed to eliminate collisions between motor cars? Between motor cars and trains?

4. Under what conditions is the use of high-early-strength cement of advantage? Of disadvantage? Are any precautions necessary?

5. At what point in the rail-laying operation should the anti-creepers be applied? Why?

6. To what extent should the minimum head be given consideration in selecting motors for driving centrifugal pumps? Why?

7. Is it advisable to assign certain days of the week or month for section gangs to pick up scrap and do other forms of policing? What are the benefits?

8. How often should screens be painted? When should this be done? What is the best type of brush to use?

that they are in good operating condition and are lubricated.

3. See that the cutting heads are properly adjusted.

4. See that the push car is properly equipped for sharpening bits and has enough extra bits and cutting heads, and that it is ready to follow the adzing machines.

5. Crib the ballast, sweep the ties, drive down spike stubs and plug spike-holes.

6. Adze the ties.

7. Brush hot creosote on the adzed surfaces to retard decay.

Get Even Bearing on Ties

By C. E. Miller

Assistant Engineer of Maintenance, Chicago & North Western, Chicago

Three things are involved in adzing ties, (1) to obtain a full even bearing for the tie plates, on solid wood; (2) to do this with the removal of the minimum amount of wood; and (3) to protect the adzed surface with an effective wood preservative.

The life of a tie should not be sacrificed by cutting deeper than is necessary to obtain the desired results and the finished work should be done as accurately as possible to assure that the adzed surface is a true plane under the tie plate and in the same plane as the corresponding surface under the opposite rail. This result having been attained, there should be minimu crushing of the fibre of the tie from uneven bearing of the tie plates, with a resultant minimum of regaging after traffic passes over the track.

In machine adzing the procedure is to throw out the rail on the side to be adzed, allowing the adzer to travel on the opposite rail. To secure a uniform plane, the cutter head must be lowered so that all bits bear evenly on a flat sawed tie, adjusting the housing carrying the cutter spindle and securing this adjustment by tightening the housing bolts and set screw provided for that purpose. As different heights of rail require readjustment of the cutter head, it will be necessary to repeat the adjustment when doubling back to lay the rail on the opposite side of the track.

It is equally important to establish the proper longitudinal center line of the adzed area with relation to the center line of the rail, so that the cut will best fit the tie plates being used. This adjustment is accomplished by varying the adjusting washers on the axles of the adzing machine until the proper centering is obtained.

Ties should be adzed only the amount necessary to obtain a full even bearing on solid wood for the full width of the tie. Obviously, a new tie should require no adzing, and such result is obtained by setting the cutter bits to protrude from the head by an amount equal to the thickness of the gage plate that is provided at the bottom end of the cutter spindle.

In this position, the gage plate contacts the surface of the solid wood at the seating on the tie and the cutters cannot cut below this depth. This means that a new tie will not be adzed. On a rail-cut tie, the gage plate does not contact the original rail seat until the cutters have reached the level of this seat, and the tie will therefore be adzed to the full width necessary to receive the tie plate.

It is also important to keep the cutter bits reasonably sharp at all times to secure rapid cutting and to assure a smooth cut surface, rather than a tearing of the wood fibre. Finally, it is essential to the life of the tie that the adzed surfaces be coated with a wood preservative, since most or all of the originally-treated zone is removed in the adzing process and decay will follow rapidly at the point most detrimental to the tie and the track, unless the exposed surface is protected.

Repairing Leaks in Roofs

What methods should be employed to repair leaks in a pitch and gravel roof?

Watch the Flashings

By F. R. Judd

Engineer of Buildings, Illinois Central, Chicago

In general, tar and gravel roofs of five-ply construction are guaranteed for 10 years by the contractor who applies them. A well-applied roof of this type will often give trouble-free service for as long as 15 years, but it is advisable to make a careful inspection at the end of the guarantee period with the view of correcting any deterioration that may have occurred. From an economic as well as a utility standpoint, such roofs should be maintained as follows after the expiration of the guarantee period:

(1) Sweep the roof thoroughly to remove all loose accumulations; (2) repair and fasten all flashings at the intersection of the roof plane with vertical surfaces, such as walls, chimneys, skylights, ventilators, etc.; (3) repair and patch the body of the roof where required, using two plies of 15-lb. tarred felt mopped on; (4) After repairing, mop the entire surface with hot tar and pitch and restore the gravel. Gravel removed from the roof in preparation for making the repairs can be cleaned of dirt and reused on the repaired surface, but such new gravel as may be required should be added. A roof repaired in this manner will ordinarily give at least eight years additional satisfactory service and at the end of this period the procedure may be repeated.

Ordinarily, where occasional leaks develop in a composition roof of recent application, they occur around the flashings. If in the flashing, and where there is no counterflashing, the lath fastenings should be renailed and given a hot mopping of tar and pitch. Occasionally, leaks will develop in the body of the roof, and in such cases it may be extremely difficult to determine their exact location. In making repairs it is necessary to bar down the gravel to a reasonably smooth surface over the area that is believed to contain the leak. After the surface has been cleaned thoroughly, it should be mopped with hot tar and pitch and two layers of 15-lb. saturated felt should be applied, each of which should be given a hot mopping, so that in no place shall felt touch felt. The entire surface should then be given a final mopping, followed immediately by the application of the gravel while the tar is still hot.

Have Long Life

By Supervisor of Bridges and Buildings

Despite the fact that this is one of the oldest types of roof now in common use, and despite the further fact that other materials have been developed for roofing, many of which give excellent results, this type still remains as one of the outstanding long-life roofs. When properly applied with materials of good quality it should require little maintenance for many years; in fact, dependable contractors do not hesitate to guarantee five-ply roofs of this type for 10 years, and I have known more than one to go for as long as 15 years without requiring attention.

When leaks do occur, they may be quite baffling, for the indications of a leak often appear at a considerable distance from the actual defect. The usual method of locating it is to remove the gravel and sweep the surface clean at the apparent point of leakage, and then work upward on the slope until it is found. On a very flat roof, however, the leak may be well to one side of the supposed location instead of above it, making the search still more difficult.

When found, the surface for some distance around the defective area should be cleaned thoroughly and mopped with hot pitch, this area to extend well beyond the leak. A patch, consisting of two or three layers of 15-lb. tar-saturated felt, each succeeding layer of which should overlap the preceding one by at least 6 in., and the first one to extend beyond the affected area, should then be applied. The technic of this application is the same as that for applying a new roof; that is, each ply should be laid in and mopped with hot pitch, the joints should overlap the same as for a new roof, and the gravel should be replaced while the last mopping is hot.

As the roof becomes older, if leaks become frequent, the whole surface should be cleaned and examined. If the felt is dried out and badly cracked, about the only remedy is to renew the roof. If it is apparent that considerable life still remains, two additional plies can be laid over the whole roof, in the expectation that it will last from 5 to 10 years longer. In fact, I have seen roofs carried until there were as many as 10 or 12 plies before it became necessary to renew them because of persistent cracking.

Elevation Blocks on Bridges

Should elevation blocks on open-deck timber trestles on curves be placed on top of or beneath the ties? On open-deck steel spans? Why? If on top, what means can be employed to cant the low rail to conform to the superelevation?

Place Under Tie

By H. Austill
Chief Engineer, Mobile & Ohio, St. Louis, Mo.

The question implies that elevation blocks definitely are to be used, and since the principle is the same for trestles and open-deck steel spans, this discussion will not distinguish between them. Elevation blocks should be placed under the ties, over both stringers, and should be properly tapered and bolted to the ties. Being under the ties, they are less exposed to the sun and are, therefore, less apt to warp and split.

If they are placed on top of the ties, they may be destroyed by a derailment. They probably will be split by the track spikes and the movement of the rail, as well as warped by the sun. As a result of these hazards they cannot be expected to have a service life equal to that of the ties, even if they are treated.

I understand that in a few cases elevation blocks have been used on top of the ties, under the outside or high rail only. I have never seen this type of construction and would not use it, as the axes of the two rails would not be in parallel planes. Of course, a tapered dap could be cut into the top of the ties to accommodate the low rail and give it the same cant as that of the high rail. If I were to use an elevation block on the top of the tie under the high rail only, I would do this.

One advantage in the use of elevation blocks is that one can use ties having the standard cross section. For this reason it is preferable to the use of tapered ties, or of extra deep ties dapped over the stringers to give the required superelevation.

Other means of providing superelevation in trestles, in the order of my own preference are:

1. To cut off the piles or posts to the necessary inclination, thus putting the elevation in the caps. This will permit all of the timber in the deck to conform to the standard in use.

2. To use a tapered slip cap on top of the standard cap.

3. Frame the elevation in corbels placed under the stringers on top of the caps.

4. Use a tapered tie under the standard tie.

In some cases framed bents have been tilted on the bottom sills and have proved to be satisfactory.

Put Elevation in Bents

By S. F. Grear
Assistant Engineer of Bridges, Illinois Central, Chicago

Open-deck timber trestles should have the elevation framed into the bents, so that flat ties having uniform cross section will rest directly on the stringers. If this cannot be done for any reason, or if it becomes necessary to change the superelevation, the blocks should be put under the ties. This permits the rails to be spiked firmly to a single piece of timber, which will aid materially in holding the gage, as well as place the bases of the two rails in the same plane with the proper cant.

Any blocks that may be placed under the ties must be of sufficient length to permit them to be bolted to the ties. The block, which obviously will be under the high rail, and the opposite end of the tie, under the low rail, must be framed to provide a flat and even bearing on the stringers. The same rules apply to the superelevation or steel spans.

Has Several Choices

By General Inspector of Bridges

This matter, like many others connected with the design and maintenance of structures, has never been fully settled, and today one can see several methods in use for providing superelevation on both timber and steel structures. My own preference is to avoid elevation blocks wherever it is practicable to do so.

In general, there is no reason why the elevation cannot be framed into the bents when they are erected. While this will necessitate some departure from the standard of the road for that portion of the structure below the caps, it presents no difficulty and has the advantage of permitting standard construction for the deck.

If it becomes necessary later to change the elevation on the curve passing over the structure, this can be done in several ways. On a trestle, elevation blocks can be applied, either on top or beneath the ties, a longitudinal timber of the proper thickness can be used under the ties, or wedge-

shaped ties can be substituted for the ties normally used. Personally, I prefer the elevation blocks placed under and bolted securely to the ties, with a slight framing to give the ties a flat bearing under the low rail. Usually this change in elevation is slight; in fact, it may be so slight as to present a problem from this viewpoint only, for it is easier to install a shim 2 in. or more in thickness than one that is less than 1 in. thick.

In principle, provision for superelevation on steel bridges does not differ from that on trestles, but practically there may be some difference in making the application, because of the differences between a steel stringer and a timber chord. In this case, I prefer to place the elevation blocks beneath the ties rather than on top, although I have seen many cases of superelevation by the latter method that were apparently satisfactory.

Replacing Anti-Creepers

Should anti-creepers that have been removed during tie renewals be replaced against the new ties or against adjacent ties that have not been disturbed? Why?

Give Solid Support

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

The answer to this question must be made conditional on several factors, including the kind of wood in the ties, the condition of the adjacent ties, whether the track has been raised or the ties dug in and the kind of ballast. The principal requirement in the application of anti-creepers is that they shall be given a solid support to resist the forces that cause the rail to creep.

When a tie is renewed it is conceivable that the ties on either side of it have only one or two more years of service life left in them. If this is the case it stands to reason that they will not be suitable for placing anti-creepers against them, particularly if they are beginning to get soft. On the other hand, if it has been necessary to break up the old bed to get the new tie in, it will not offer as much resistance to the pressure of the anti-creeper as it will later after it is more solidly supported. It becomes, therefore, a matter of judgment as to the probable holding power of the new and old ties.

If the track has been raised an inch or more, it is likely that the new tie will offer as much resistance as any of the remaining ties in the panel, and the anti-creepers should be replaced against it. Again, certain types of ballast offer much less resistance to the movement of the ties when newly replaced in the cribs than after they have had an opportunity to settle and pack.

In general, anti-creepers are distributed uniformly or symmetrically throughout the panel, and this is as it should be, for no hit-and-miss arrangement can be as good as one based on a reasonable system. For this reason, I would hesitate to change the location of the anti-creeper unless there is some good reason for doing so. If that reason appears, I would not hesitate ot make the change.

Against Adjacent Ties

By W. Woolsey
Section Foreman, Illinois Central, Chicago

When anti-creepers have been removed to permit the renewal of ties, they should be replaced against adjacent ties, because the latter have not been disturbed and will, therefore, offer greater resistance to the forces that cause the rail to creep. When a new tie is installed, no matter how solidly it may be tamped or how carefully the crib has been back filled, it is never able to resist the force exerted by the anti-creeper as well as it will after it has been in the track, say, for a year.

Even if the new tie has as solid a bearing on the ballast bed as a tie that has not been disturbed, it still will not offer the same resistance to the anti-creeper, for the ballast that has been replaced in the crib remains unsettled and loose, and it is this ballast which in the last analysis offers the resistance that is required to keep the rail from creeping. To repeat for emphasis, an anti-creeper should not be placed against a tie that has been in the track less than a year, for the ballast in the crib will not be properly settled in less time.

Obviously, if the track has been given a general raise and the ballast has been removed and replaced or otherwise loosened in all of the cribs, it will make little difference, so far as resistance is concerned, which ties are selected for replacing the anti-creepers. However, where the ties have been dug in there is a decided difference in the resistance offered by the new and the old ties.

Exactly as They Were

By Division Engineer

All of our experience leads us to believe that there is no reason why the anti-creepers that are removed from the rail for the purpose of making tie renewals cannot be replaced exactly as they were, after the new ties have been inserted. In other words, after new rail is laid, the ties are spaced and the anti-creepers are applied to the ties numbered 1, 3, 6, 9, 12, 15, 18 and 24 in each panel, and when tie renewals are made the location of these anchors is not changed.

Our standards emphasize the desirability of using a uniform system of spacing for the anti-creepers rather than their application in accordance with the tie condition. Perhaps, if the tie condition were allowed to fall far below normal, it might be necessary to take this condition into account and change the spacing until the deferred maintenance could be overcome, but this has never happened in my experience. For these reasons, our practice does not permit a choice in the location of the anchors, but requires that the original spacing be maintained at all times.

Makes Little Difference

By Leo J. Simons
Section Foreman, Chicago & North Western, Beaver, Iowa

It has been my experience that it makes little difference which ties anti-creepers are replaced against, for there are two ways of looking at the matter. When anti-creepers are replaced against new ties, they have a tendency to move them a little, but as all new ties inserted today are equipped with tie plates this movement is so small that it does not matter. For this reason, it is my viewpoint that the anti-creepers should be returned to the ties that replaced those they were formerly against, for unless they are there will be no system in their application.

I am a firm believer in system, in this case, of having the anti-creepers placed against certain ties in the panel. Otherwise, after a few seasons they will become bunched and will not be as effective as if they are distributed

approximately uniformly throughout the panel. Again, it is my observation that even with close supervision, men tend to become careless if they find that a system that they have been taught to follow is being broken up. This applies to anti-creepers just the same as to other things, and if there is no uniformity in the placing of them they will put them on where it is the handiest to do so, and less benefit will be obtained from them.

Spray Painting Interiors

Is it practicable to paint interiors by the spray method? If not, why? If so, what methods and precautions are necessary that are not required for brush painting?

Is Common Practice

By G. A. Rodman
General Supervisor of Bridges and Buildings, New York, New Haven & Hartford, New Haven, Conn.

I consider spray painting of interiors not only entirely practicable, but desirable. My observation leads me to believe that it is a common practice; we have been doing it for the last 10 years. The spray method is most economical where large areas of wall or ceiling surfaces are to be covered with solid colors. It will rarely be economical to assemble the paint-spraying apparatus for one or two small rooms, but where an extensive program of painting is being carried out, this method will effect a material saving in cost.

When spray painting, it is essential that the men have a substantial staging to work from, as they must have a firm footing, since both hands must be free to handle the spray gun and hose. It is also necessary to have an ample supply of drop cloths to protect furniture, rugs and woodwork. Lighting fixtures should be taken down or draped with cloths to protect them from the spray. The operators of the spray guns should be picked and trained for the work, preferably from among the younger men who have not had too much experience in brush painting, as it seems to be very difficult for the older men to learn new methods.

It Is Practicable

By W. E. Gardner
Principal Assistant Engineer, Wabash, St. Louis, Mo.

Interiors of large offices, particularly those with high ceilings, and almost all station and shop buildings not only can be painted by the spray method, but this should be done as a matter of economy. There are a few places where brush work will be more satisfactory, such as offices crowded with desks, chairs, cabinets and other office equipment, which usually is not to be repainted. There will also be a few cases where the amount of painting that can be done with the spray is so small that neither the expense of setting up the equipment or of changing the colors in the equipment can be justified. An experienced foreman is able to decide when brush painting will be more economical.

Color standards for economical interior painting should call for only one wall color and a darker color for the trim. This will eliminate the necessity for changing colors in the spraying equipment, for in most cases it will be used for painting the walls and ceiling only. In the use of the paint-spray guns it is quite difficult to strike a sharp line of demarcation, as can be done with a brush. As a consequence, a certain amount of the wall paint can be expected to get onto the window and door casings or other woodwork. This can be avoided by covering the parts upon which the trim is to be applied, but this is scarcely worthwhile, for the dark trim color can be applied by brushing to cover the lighter wall color that may have settled on the area to be trimmed.

When the paint spray is used, only one type of wall paint is required, since it is not essential that the first coat have the "tooth" that is so necessary to obtain dependable results in hand painting. Painters can be better protected and fire hazards kept to the minimum if interior painting can be done during the summer after stove fires have been discontinued and full ventilation of the building can be provided.

Painters who indicate a tendency to be easily susceptible to lead poisoning should not work on interior painting where the spray method is used. The use of helmets, while providing the maximum protection against the paint, creates a hazard by interfering with full vision. This is particularly dangerous when working on a scaffold. In these cases it is better to use a respirator which will afford ample protection for a careful painter.

An important part of the paint foreman's duties is to see that the men use every precaution to prevent constant contact with paints. If this practice is adhered to rigidly, there is little more danger connected with interior work than with outside painting. However, it is always well to alternate the men on the gang.

Cast Iron for Suction Lines

Is it practical to use cast iron pipe for suction lines? If not, Why? If so, under what conditions?

Has Used Cast Iron

By F. P. Turner
Principal Assistant Engineer, Norfolk & Western, Roanoke, Va.

During the last 20 years we have constructed about 30 new pumping stations, every one of which has been equipped with motor-driven centrifugal pumps. Cast iron pipe has been used for the suction lines at all of these plants, many of them having been laid with leaded joints, except at the connections to the pumps and to the foot valves. At these two points we have used flanged pipe. We have never had any trouble with any of these suction lines.

Ordinarily, the pump wells extend to low water or to within 5 ft. of low water. The suction lines are usually covered with either earth or riprap from the face of the pump house to the suction intake.

Can Be Used

By Supervisor of Water Service

There is no reason of which I am aware why cast iron pipe cannot be used successfully for suction lines, although certain precautions are necessary where this is done. The requirements for a suction line, regardless of the material used in its construction, is that it be as near "bottle tight" as possible, to eliminate

the possibility of air entering the suction line and breaking the suction of the pump. Where a reciprocating pump is used, it is necessary to create a vacuum in the suction in order that the pipe may be filled with water by atmospheric pressure. For this reason, the importance of an air-tight suction line increases as the lift increases, as the suction lift is governed by the atmospheric pressure at the point of its use.

Atmospheric pressure at sea level is normally 14.7 lb. per sq. in., which is equal to the height of a water barometer of 34 ft., or of 30 in. on a mercury barometer. Obviously, this height decreases as the altitude increases. For example, at an elevation of 2,000 ft. above sea level, the atmospheric pressure is 13.7 lb., and the water-equivalent height of a perfect vacuum is 31.6 ft.

The total practical suction lift will never equal the equivalent height of a perfect vacuum, for certain suction losses cannot be avoided, such as the influx losses at the end of the suction line, the friction losses and the velocity losses. The temperature of the water must also be taken into account, although this has little influence on the suction lift below 100 deg., F. Altitude tables vary considerably because of atmospheric influences. The figures given are the normal values, and are sufficiently accurate for ordinary requirements.

Any objection that might be advanced against the use of cast iron for suction lines will be against the joints rather than against the pipe itself, and particularly because the joints might be affected by vibration. Obviously, this point is of first importance where reciprocating or other displacement pumps are used. There is little possibility of vibration where a centrifugal pump is used, although the tightness of the suction line is of still greater importance than with a reciprocating pump.

The principal advantage to be obtained from the use of cast iron pipe lies in its greater resistance to corrosion than steel or wrought iron pipe. Where the pipe is not subject to vibration and the joints can be kept tight, cast iron pipe is entirely satisfactory. Where the line is subject to vibration or there are other difficulties in the way of keeping the joints tight, bolted or threaded joints should be used.

Too much emphasis cannot be placed on the importance of the suction line, as this is one of the most important features of a railway pumping plant. Too often it receives the least attention, with the result that the efficiency of the pumping unit is seriously reduced and the cost of operation is increased.

Of equal importance with the material, particular attention should be given to the design of the suction line and the manner in which it is laid. A suction line should be as short and direct as practicable, avoiding all unnecessary joints and elbows. If necessary to install a long suction line, the size of the pipe should be increased to reduce the velocity and consequent friction losses. A line longer than 50 ft. or having more than two elbows should be at least one size larger than called for by the maximum delivery of the pump.

Long lines and those having high lifts should be provided with vacuum chambers, if positive—displacement pumps are used. Those for centrifugal pumps should have properly designed foot valves, and if the line is long or the lift is high a priming device should be provided to fill the suction line with water before the pump is started to insure a steady and dependable flow of water to the pump.

Effect of Tie Plates on Rail

What effect, if any, does the size of tie plates have on the life of rail? Why?

Holding Gage Helps Rail

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

While tie plates are intended first of all to conserve the life of ties, they have an indirect effect on the life of the rail in that they aid in holding it to gage. Good gage is an important factor in the wear of rails, as every experienced trackman knows. Wide or uneven gage not only results in uneven wear on the running surface of the rail, but it may also cause decidedly uneven side wear, owing to continued oscillation of the wheels between the rails.

Small tie plates usually settle into the tie, sometimes deeply. When a tie plate cuts deeply into the wood it rarely goes straight down, but cuts more at one end than at the other, with the result that the rail is tipped either out or in, and the bearing of the wheels on the running surface becomes irregular, causing irregular wear. Large tie plates settle very little or not at all in the tie, and such settlement as does occur is generally without tipping, so that the rail remains upright or with the cant that was originally provided by the tie plate, and the wear on the running surface remains uniform so far as this factor is concerned. Again, a tie plate that settles unevenly affects the gage, with the result that has already been mentioned.

Summarizing the whole matter, while the difference between large and small tie plates is not likely to be the determining factor in the life of rail, other conditions being the same, I am convinced that a rail supported on large tie plates will have a longer life than one that has an inadequate support on plates that sink deeply and unevenly into the tie.

Affect Ties, not Rail

By A. A. Miller
Engineer Maintenance of Way, Missouri Pacific, St. Louis, Mo.

Tie plates are used to increase the life of ties rather than that of rail and the size of the plate has little or no effect on the life of the rail, assuming, of course, that the rail is properly supported. This means that more tie renewals will be required in a given period if the plates are too small to protect the ties from mechanical destruction. Large plates give better protection to the ties than small plates, but they have no corresponding advantage with respect to the life of the rail.

The purpose of the tie plate is to distribute the load from the rail over enough square inches of the tie so that the pressure on each square inch of the tie surface will not be greater than the wood can support without undue cutting of the plate into the tie. Although this cutting is thought to result from abrasive action, experience has shown that small plates cut into the tie badly while larger plates may reduce the cutting to such an extent that the decay life of the tie

may be more nearly realized. For example, creosoted ties might last upwards of 30 years if there were no mechanical destruction from traffic, whereas the same time without tie plates might last only 8 or 10 years.

Does Affect Rail

By Thor Monrad
Track Supervisor, Northern Pacific, Columbus, Mont.

While tie plates are applied primarily for the protection of the ties, and to give a more uniform bearing for the rail, the size of the tie plates does have a decided, although it may be indirect, effect on the life of the rail. The smaller the area of the tie plate, the more quickly and deeply it will cut into the tie.

When a tie plate cuts deeply into a tie, it seldom does so uniformly, with the result that the rail has an uneven bearing from tie to tie, and the contact of the tread of the wheel on the running surface becomes uneven, causing uneven wear. Since the life of the rail depends to a considerable extent on an even support, the larger tie plates do lengthen the life of the rail, since they do not abrade or cut into the tie to the same extent as the smaller plates. Furthermore, what abrasion does occur under large plates is more likely to be uniform, so that what little settlement they get does not tend to tip them.

Switch-Point Guards in Yards

Is there any advantage in applying switch-point guards at yard turn-outs? Why? If so, should they be applied at all turnouts?

They Are Effective

By H. F. Fifield
Engineer Maintenance of Way, Boston & Maine, Boston, Mass.

It has been the practice on the Boston & Maine to apply switch-point guards at all turnouts in yards where the wear on the points has been excessive. We find that by doing so, the life of our switches is at least doubled, and in some instances it is increased as much as three or four times. We apply the guards only to those turnouts that are subject to heavy wear, thus increasing the life of the switches at these places to approximately that of the switches in the remaining portion of the yards. The cost of a switch protector in place, compared with the cost of renewing the switches several times, warrants the installation of the guards.

Favors Their Use

By W. E. Folks
Track Supervisor, Cleveland, Cincinnati, Chicago & St. Louis, Cincinnati, Ohio

I recommend the use of switch-point guards, for they are a good investment for any busy yard. Our experience with them has been very satisfactory, especially for short turnouts and turnouts on sharp curves. They demonstrate an economy that is not measured alone by the extended life of the switch points, but in large part by the labor involved in making relatively frequent renewals, as well as that of trying to keep the points in good operating condition between renewals. I do not hesitate to say that their use is warranted at any turnout where the points wear rapidly without them.

Have Many Advantages

By W. Allan
Section Foreman, Canadian Pacific, Montreal, Que.

Switch-point guards, installed either on the inside or outside of the stock rail are of definite advantage, since they protect the switch point from excessive wear from the flanges of the wheels for a distance of 15 or more inches back of the point. This wear thins the point so much that the metal eventually breaks out, leaving a blunt edge which will lift the flanges and cause the car to be derailed.

If switch-point guards are properly installed and are kept well lubricated, they will actually throw the wheels over far enough to eliminate contact with the points, thus affording sufficient clearance not only to avoid wear on the point, but to obviate the probability of the wheel climbing the point, even if it should become chipped enough to be blunt, or of splitting the switch if it does not fit tightly against the stock rail.

Switch-point guards are of two classes, namely, those that are applied inside of the rail and those placed on the outside. The first class includes the ordinary form of guard rail, but shorter, placed on the opposite side of the track from the point to be protected, functioning the same as the ordinary guard rail at a frog; short blocks of metal, properly formed, which are bolted on the gage side of the rail, fitting tightly against the head and web of the rail; and somewhat similar devices welded to the rail. The second class is placed outside of the rail, to contact the outside of the wheel, as in self-guarded frogs.

Outside guards must be placed opposite the point to be protected, while the inside guards are placed a short distance, 4 to 5 in., ahead of the points, to insure the necessary clearance for the operation of the points. I have found them to be particularly effective at short or sharp turnouts, since such switches are particularly subject to derailments.

Where a large amount of traffic passes through a turnout the wear on the points is rapid unless some form of protection is provided, and both the points and the stock rail must be changed frequently. Where this protection, in the form of guards, is given, the life of the points and of the stock rail is greatly extended, in addition to which the turnout remains safe for operation until wear has reached the point where renewals are necessary. In other words, wheels do not climb points that are properly protected, for they do not wear blunt or break.

When a pair of wheels is forced to change direction in passing through a turnout, not only do the wheels exert a heavy pressure against the outside point, but in effect they strike a heavy blow, and the greater the wear on the point the greater is the danger that it will be broken.

Outside guards, because of the stock they receive, have a tendency to cause wide gage. I have been able to overcome this, however, by installing a gage plate on the tie ahead of the head block. On the other hand, if the inside guard—not the guard rail type—becomes badly worn or chipped, it may cause a derailment. For this reason, guards of this type should be given frequent inspections and be renewed before wear has progressed to the danger point. I endorse the use of switch-point guards for any yard turnout that carries a sufficient volume of traffic to warrant their use. This can be determined very definitely by comparing the cost of switch-point renewals with that of the guards and with the saving they will effect.

What Our Readers Think

The Transit Method Defended

St. Louis, Mo.

TO THE EDITOR:

In the April issue of *Railway Engineering and Maintenance* there appeared an article by Philip Kissam, associate professor of civil engineering, Princeton University, in which it was stated that the string lining method of computing curves is more accurate than the transit method. It is true that there are many things to be said for the string lining method. We use it extensively and with marked success, but it is not more accurate than the older transit method, and I am inclined to take issue with some of the assertions made in the article.

The statement is made that "when a curve is staked out with a transit, the general alinement of the curve will be very nearly circular but irregularities will appear between adjacent alinement stakes." This might be true if the stakes are set at 100-ft. intervals, but if they are set with a transit at, say, 40-ft. intervals, as is the usual practice in the string lining method, then what is the difference?

Figure 1 in the article shows errors that are made when setting stakes with a transit. As I read this diagram the average error for 10 tests for a distance of 800 ft. was about one eighth of an inch. That speaks well for the transit, well for the transitman, and very well for the steady nerves of the men holding the plumb bobs over the points by hand. I point out that the error could probably have been reduced by using a pencil *on* the points rather than a plumb line held over them. Also, I venture to say the one-eighth inch average error was less than one tenth the probable average error that would be likely in going the same distance on short chords with a string. I am at a loss therefore, to understand how Prof. Kissam reaches the conclusion that "adjacent stations 50 ft. apart, set by transit, may differ as much as 1 in. in alinement without discovery."

Long curves that are not badly in need of alinement can be quickly and satisfactorily string lined for high speeds. The string lining method can also sometimes be used satisfactorily where curves are in a very bad condition, or when it is desired to lengthen the spirals or increase the radius, but such curves are more often better lined with a transit, providing a good transitman and several good chainmen are available. It is true that the latter are important, and they are seldom available on railroads. There are many ways in which work with a transit may be checked, and when the curve is lined in this manner a more positive record of its properties is available.

GEORGE W. PAYNE,
Assistant Engineer
Missouri Pacific

Prof. Kissam's Reply

Princeton, N. J.

TO THE EDITOR:

Mr. Payne's letter raises two main points, viz: (1) Is the transit more accurate than string lining? and (2) could two adjacent lining stakes set with a transit vary from line a total of one inch? The answers developed below indicate that string lining is at least three times as accurate as the transit method and that an error of 1 in. is conservative.

Since preparing the article mentioned by Mr. Payne, the writer has made extensive tests on various transits to determine the actual error of the transit alone (eliminating the error of sighting on a plumb bob and setting the tack). The average transit has a probable error of ± 6 sec. and 10 per cent of the shots have an error of $\pm$ 20 sec., or more. These errors include the two vernier settings necessary for the backsight and the foresight. This means that for a 400-ft. sight, half of the points will be set 0.007 ft. off line and 10 per cent of the points will be set a minimum of 0.024 ft. off line.

It will be noted that these figures check closely with the diagram in the article. When adjacent stakes are set with errors of opposite sign, the effect on the track alinement is equal to the sum of the errors. Two adjacent probable errors of opposite sign would cause an irregularity of 0.014 ft., and two errors of opposite sign that occur 10 per cent of the time would cause a variation of 0.048 ft.

Comparative string lining errors may be assumed to be 1/32 in. and 1/10 in., and irregularities under conditions of opposite sign 1/16 in. and 1/5 in. These figures make string lining three times as accurate as the transit.

But the transit itself can be as much as 30 sec. off as the tests proved. When a pencil is used, the effect of the mirage—and when the plumb bob is used, the effect of the swing—will introduce further errors not found in string lining. When the transit error is 30 sec. and the mirage causes an error of only 1/16 in. on each sight, the total error is .08 ft. It must be remembered that this may occur at any time.

But the proof of the pudding is in the eating. The writer used the string method to line all four tracks of the Elizabeth (N. J.) curve of the Pennsylvania, which is on the main line about 25 miles from New York. This curve is composed roughly of three parts, a 1-deg. curve, a 2-deg. 45-min. curve, and a 2-deg. 30-min. curve in the opposite direction. It is about 4,500 ft. long and is carried on three bridges and a viaduct. Restrictions were imposed by the platforms of the Elizabeth depot which extend along both sides of the curve for a distance of about 800 ft. and by an interlocking at one end. The clearances, moreover, were almost at the limit. The curve rode beautifully when the track work had been completed.

PHILIP KISSAM,
Associate Professor
of Civil Engineering,
Princeton University.

String Lining Curves on the Milwaukee

La Crosse, Wis.

TO THE EDITOR:

Noting Professor Kissam's article on the string-lining of curves for high-speed service, the Milwaukee used the string-line method in 1934 for the adjustment of all curves between Chicago and Minneapolis in preparation for its Hiawatha service, with good results not only from the standpoint of economy but, far more important, from that of securing smooth riding curves. The only use made of the transit was to extend the true tangent and secure from that base line offset readings to the track at the stations on the high rail, for short distances at the ends of the curves.

This modification accomplished two desirable things. It effected the minimum shifting of the tangents to conform with the curves, and also through computation of the middle ordinates from those offsets it afforded a more accurate determination of the small ordinates near the ends of the spiral curves. I believe that it

is quite important to obtain the correct relationship between tangent and spiral for high-speed track in that way.

As to economy—a four-man party averaged a mile of curve a day, including all operations, and all who have had experience with curve readjustment by transit know that such speed cannot be approached when using this instrument.

It cannot be stressed too much that the most careful workmanship is essential to the success of the string-line plan. This includes the data measurements, the computations and selection of the very best possible alinement, and the setting and final checking of the curve points, as staked, so as to insure correctness. I am convinced that the disdain or lack of confidence that many of the old-time track liners felt for stakes was brought about by the shortcomings of the transit method itself. This feeling has disappeared on the Milwaukee, and curve stakes are being followed today to a fine point of accuracy.

Proper elevation in both spiral and curve, as well as good gage conditions, must also be associated with good alinement to produce smooth riding curves. Unless all of these requisites are satisfied no curve will afford comfortable riding, and especially so at the higher speeds.

H. B. CHRISTIANSON,
Division Engineer,
Chicago, Milwaukee,
St. Paul & Pacific.

Superelevation for Turnouts

Chicago.

TO THE EDITOR:

I have read with interest the article in your April issue describing the practice adopted by the London, Midland & Scottish Railway of England for inserting superelevation in some of the turnouts that it has recently installed. This idea is not new, but careful consideration of the fundamental principles of turnout design in this country has led to the general conclusion here that the abrupt change of direction at the switch point in a turnout makes it impossible to introduce the elevation necessary to compensate for the rate of deflection at this point.

When a curve is encountered in open track it is the practice, in order to obtain comfort as well as safety, to provide a suitable form of easement or spiral at each end of the curve in order to counteract the rate of deflection by a suitable amount of elevation to overcome the effect of the change of direction when equipment is moving over the track at high speed. In the construction of a turnout it is necessary to introduce an abrupt deflection in the form of the switch angle, which necessitates the reduction of the speed at which trains may negotiate a turnout to a point where safety and a sensation of comfort will be experienced when negotiating the switch angle.

In the plans for a 39-ft. switch that were recently adopted by the A.R.E.A. a switch angle of 0 deg. 25 min. was adopted because that was considered the minimum angle to which it would be practicable to plane a switch rail. By trial it has been shown that such a deflection in alinement may be negotiated with safety and without undue discomfort at a speed of 55 m.p.h. With this limitation imposed by the angle of deflection of the switch point, the alinement through the remainder of the turnout may be such that elevation is not necessary because of this restriction in speed.

As there are no outstanding difficulties in manufacturing a switch of uniform curvature throughout its entire length, such a procedure was followed in the design of this turnout, providing a uniform rate of deflection from the point of the switch throughout the turnout to the toe of the frog. We believe that this arrangement is more simple in construction and in maintenance than when elevation is introduced through the lead and should provide less disturbance to the equilibrium of equipment than would be the case where elevation is introduced without properly equated easements and runoffs.

TRACK ENGINEER.

New Books

Railway Points and Crossings

RAILWAY Points & Crossings, Theory and Practice, by Neville H. Cour-Palais, assistant engineer, Bengal-Nagpur Railway, India. 420 pages. Bound in cloth. Published by Thacker, Spink & Co., Ltd., Calcutta, India. Price 13 shillings and 6 pence (about $3.37).

This is a comprehensive treatise on turnout engineering which is designed for use either by the practical track man or by the student as a text book. While it is based primarily on the track practices and standards applying in India and other British dominions the formulas and mathematical analyses are so arranged that they may be interpreted in terms of practices in other parts of the world, including the United States. As is to be expected, the terminology employed varies considerably from that in use in this country, but the various terms used are easily interpreted so that they in no way detract from the value of the work as a handbook for use by American track men.

Beginning with a chapter on trigonometry and another on the elementary mathematics of circular curves, the work takes up, in successive chapters, the mathematical analysis of the many different situations that are encountered in the computation of turnouts. In this respect the author has endeavored to bring all the systems of calculation within the compass of one volume, as well as to make the formulas applicable to railways of all gages. There are also chapters on crossings, double crossovers, slip switches, three-throw switches, wye tracks and ladders. Tables of natural trigonometric functions and of other values helpful in the computation of turnouts are also included.

Turnouts for Broad-Gage Track

POINTS and Crossings, Broad Gage, Third Edition, by K. N. Salkade, Permanent Way Inspector, Great Indian Peninsula Railway, Shahabad (Deccan), India. 368 pages. Bound in cloth. Published by Mr. Salkade.

This is the third edition of a handbook and text book on turnout engineering that is widely used in India and elsewhere. With this edition the book has been brought up to date and has been enlarged by the addition of a chapter on elementary trigonometry and mensuration and by the inclusion of new analytical material. Through the addition of the chapter on trigonometry the author hopes to widen the usefulness of the book by making it readily understandable to those whose training in mathematics has been limited.

In this work the mathematics of turnouts is treated in a comprehensive manner, and the author has been careful in every instance to outline the derivation of the formulas so that the reader has an opportunity to gain a thorough understanding of the theories involved. As is the usual practice in works of this type, the subject matter consists largely of the presentation of formulas for dealing with the many different situations encouraged in the computation of turnouts. While the material is applicable particularly for use where the gage is 5 ft. 6 in., the formulas, to a large extent, may be readily adapted for application to other gages.

NEWS of the Month

Railroads Operate at Loss in February

In February the Class I railroads of the United States had an operating deficit of $2,136,481, as compared with a net railway operating income of $38,792,779, or a return of 2.6 per cent on their property investment on an annual basis, in February, 1937, according to the Bureau of Railway Economics of the Association of American Railroads. Gross operating revenues for the month of February amounted to $251,173,946, as compared with $321,959,564 in February, 1937. Operating expenses in February totaled $215,487,459, as compared with $244,153,636 in the same month of the previous year.

Three Passenger Fatalities in 1937

During 1937 only three passengers lost their lives in train accidents on railroads in this country, as compared with seven such fatalities in 1936, according to the Association of American Railroads. "By a strange coincidence," said the A. A. R., "the only three lives lost in train accidents in 1937 resulted from two accidents on two separate railroads and took place last November within two days of each other. One was a rear-end collision in which one passenger was killed. The other was a derailment in which two passengers lost their lives." Passengers injured in train accidents in 1937 totaled 536, as compared with 742 in 1936.

I.C.C. Denies Plea for Coach Rate Increase in East

On April 14, the Interstate Commerce Commission issued a decision denying the petition of the Eastern railroads for an increase in basic coach fares from 2 cents to 2.5 cents per mile. That the commission was not unanimously of the opinion that the railroad's plea should be denied is indicated by the fact that 5 of the 11 commissioners voted against the ruling, including Commissioners Eastman, McManamy and Mahaffie, each of whom filed separate dissenting opinions. The commission in its report contended that the reduction in passenger fares in the East from 3.6 cents to 2 cents, ordered by the commission in its decision of February 28, 1936, was the best solution of the coach problem, and pointed out that this solution "has resulted, apparently for the first time in many years, in eliminating or in coming close to eliminating any deficit from that service," and, regarding the proposed rate of 2.5 cents, said "the conclusion is irresistible that the proposed fare would be hurtful both to the railroads and to the public. . . . "

Expect Decrease in Second Quarter Loadings

A decrease of 17.7 per cent in loadings in the second quarter of this year as compared with the corresponding period of 1937 is expected by the shippers' regional advisory boards. On the basis of estimates just compiled, it is estimated that freight car loadings of the 29 principal commodities will total 4,989,840 cars in the second quarter of this year, as compared with actual loadings of 6,060,370 cars in the corresponding period of last year. Car loadings are expected to decrease in the second quarter in 12 of the 13 regions, with an increase of 1.7 per cent being expected in the Southwestern region. The decreases expected range from 3.5 per cent in the Central West to 44.4 in the Great Lakes region.

Railroad Buying in 1937 Shows Increase

During 1937 the railroads of the United States spent $1,184,175,000 for supplies and equipment, an increase of approximately $112,375,000, or 10.5 per cent, over 1936, and of approximately $736,451,000, or 164 per cent, as compared with 1932, according to figures compiled by the *Railway Age*. Purchases of equipment, materials and supplies for 1937, exclusive of fuel, amounted to $892,148,000, an increase of approximately $96,000,000, or 12 percent, as compared with 1936. Purchases in 1937 included $45,701,000 for rail, as compared with $38,551,000 in 1936; $14,016,000 for frogs, switches and crossings, as compared with $8,870,000; and $37,225,000 for track fastenings, as compared with $32,565,000.

That the increase in railroad purchases which occurred in 1937 is not continuing into the present year is indicated by purchase figures for the months of January and February. These show that materials received and ordered from manufacturers during these two months total approximately $73,000,000, as compared with $190,000,000 in 1937, a decrease of 61.4 per cent.

Washington Concentrates on Railroad Problem

During April the problem presented by the growing financial difficulties of the railroads came in for a great deal of attention at Washington and numerous suggestions and recommendations for aid to the carriers were put forward by various individuals and organizations. These activities culminated on April 26 in the formulation by congressional leaders and representatives of the administration and the railroads of a three-point emergency program which is to be embodied into a bill and submitted to Congress for action at the present session. Briefly, the program calls for: (1) Loans to railroads to purchase equipment, using the equipment as security; (2) so-called work loans which would be used for the re-employment of railroad employees furloughed since last October; and (3) relaxation for one year of restrictions governing the making of Reconstruction Finance Corporation loans to the carriers for various purposes.

Other developments during the month affecting the railroads included submission to Congress by the President of recommendations made by his three-man railroad committee of Interstate Commerce Commissioners. Two of the committee's recommendations are embodied in points (1) and (3) of the foregoing emergency program. It also recommended that land grant reductions in rates on government traffic be eliminated, that provision be made for speeding up railroad reorganizations, and, for the "long term", that a three-man Federal Transportation Authority be created whose object, broadly, would be to seek the elimination of competitive waste in the transportation industry.

Railroad managements also proceeded during April with plans to seek wage reductions as a means of forestalling serious financial difficulties in the industry.

Unemployment Insurance Bill for Railroad Employees

Bills have been introduced in both houses of Congress providing for a national system of railroad unemployment insurance, which will affect approximately 1,000,000 railway employes. The bills are being sponsored by the Railway Labor Executives Association and it is expected that they will seek early enactment of them. The proposed legislation would be a substitute for the various state systems now functioning, and, under the plan, the railroads would be taxed 3 per cent on payrolls up to $300 a month for each employe. The bill provides that the eligibility of employes to receive benefits would be estimated on their earnings during a calendar year. An employe earn-

ing between $150 and $199.99 in the base calendar year would receive $1.75 a day unemployment compensation for a maximum of 80 days in a 12 month period. Employes earning between $200 and $474.99 a year would receive $2 a day for a maximum of 80 days; those earning between $475 and $749.99 would get $2.25 a day; those earning between $750 and $1,024.99, $2.50 a day; those earning between $1,025 and $1,299.99, $2.75; and those earning $1,300 or over, $3.

Addition to Editorial Staff

John S. Vreeland, formerly a track supervisor on the Chicago, Rock Island & Pacific, has been appointed associate editor of *Railway Engineering and Maintenance* and of the *Railway Age,* with headquarters at Chicago, succeeding M. H. Dick, whose promotion to eastern editor of *Railway Engineering and Maintenance* and eastern engineering editor of the *Railway Age,* was reported in the March issue.

Mr. Vreeland was born on November 16, 1907, at Cincinnati, Iowa, and received his

John S. Vreeland

higher education at Iowa State College, Ames, Iowa, from which he was graduated in 1928 with the degree of bachelor of science in chemical engineering. His railroad career, all of which has been with the Rock Island, started in June, 1926. He worked that summer and also the following summer in the engineering department of that road between terms at school. Following graduation from college in 1928, Mr. Vreeland was appointed a rodman on the Rock Island, with headquarters at Cedar Rapids, Iowa. He was later promoted to instrumentman and worked on the Iowa division and on the construction and location of the Coburn-Birmingham line, with headquarters at Polo, Mo. In June, 1931, he was appointed inspector, checking the joint facility accounts of that road with the Chicago, Burlington & Quincy. In October of that year he was transferred to the Missouri division, with headquarters at Trenton, Mo. In June, 1933, Mr. Vreeland was appointed a track supervisor, which position he held successively on the Oklahoma division at Booneville, Ark., on the Iowa division at Des Moines, Iowa, and on the Missouri-Kansas division, with headquarters at Eldon, Mo. He was located at Eldon when he accepted his new position.

Association News

National Railway Appliances Association

Charles H. White, secretary-treasurer of the National Railway Appliances Association, has submitted a final report for the year ending March 31, 1938, showing a net excess of receipts over disbursements, after making a 20 per cent refund to exhibitors of rentals for exhibition space, amounting to $6,069.37. The revenues were $65,815.11, and the expenses, including the refund, were $65,258.80, leaving an excess of receipts over disbursements of $556.31.

American Railway Bridge and Building Association

It will be necessary for the Executive committee to fill three vacancies in the portfolio of officers this year, by reason of death and resignations. F. H. Masters, assistant chief engineer, Elgin, Joliet & Eastern, has resigned as first vice-president because of the pressure of other work; W. S. Lacher, who has been appointed secretary of the American Railway Engineering Association, has resigned as second vice-president; and the recent death of T. P. Soule, general supervisor of bridges and buildings, New York Central, creates a vacancy among the directors.

Maintenance of Way Club of Chicago

The annual meeting was held at the Auditorium Hotel on April 25, with 100 members and guests in attendance, the dinner and program being preceded by a reception. A. N. Williams, president and general manager, Chicago & Western Indiana, spoke on the Problems of Track Maintenance as They Affect the Operation of Railway Terminals, and also discussed at some length aspects of the railway situation, pointing out the remedial measures which have been suggested by the Association of American Railroads.

Reports were rendered by the retiring president, Col. W. G. Arn, assistant engineer, Illinois Central, and W. S. Lacher, retiring secretary-treasurer. Mr. Lacher, who has been secretary of the club since its organization, and who has recently been appointed secretary of the American Railway Engineering Association, was presented with a traveling bag by the club and with a set of table silverware by the railway supply men who are members of the club.

In the annual election which followed the dinner, A. B. Hillman, roadmaster, Belt Railway of Chicago, was elected president; George O'Rourke, district engineer, Illinois Central, first vice-president; H. R. Clarke, engineer Maintenance of way, Chicago, Burlington & Quincy, second vice-president; Neal D. Howard, managing editor, *Railway Engineering and Maintenance,* secretary-treasurer. F. J. Kramer, engineer maintenance of way, Chicago, North Shore & Milwaukee; B. R. Kulp, engineer maintenance of way, Chicago & North Western; and George Morrow, representative, Ingersoll-Rand Company, were elected directors for two years.

A. F. Blaess, chief engineer, Illinois Central, and E. D. Swift, assistant engineer, Belt Railway of Chicago, who are retiring from active service on May 1, were elected honorary members. The active membership at the end of the year was 171.

American Railway Engineering Association

John Foley, forester, Pennsylvania, has been appointed a representative of the A.R.E.A. on the Central Committee on Lumber Standards, to succeed W. E. Hawley, chief draftsman, Duluth, Missabe & Northern.

Committees held meetings during April as follows: Railway Location and Operation, at Chicago, on April 17; Maintenance of Way Work Equipment, at Chicago, on April 19; Records and Accounts, at New York, on April 20; Water Service, Fire Protection and Sanitation, at New Orleans, La., on April 25; and the Committee on Ties made inspections of tie yards at Akron, Ohio, Orrville, Bucyrus, Marion, Lima and Toledo, on April 27 and 28.

Only two committees have as yet scheduled meetings for May: Buildings in Chicago on May 24 and 25, and Economies of Railway Operation at St. Louis, Mo., on May 24.

The association has sent to the membership for letter ballot a proposed revision of the constitution that is designed to clarify certain provisions, particularly that relating to the status of associate members. The most important of these proposed revisions is that "to be eligible for election to or retention of membership as a member or an associate, a person shall not be engaged directly and primarily in the sale to railways of appliances, supplies, patents or patented services."

Train Limit Bill Stalled in Congress

The 70-car train-limit bill, which passed the Senate on July 26, 1937, became stalled in the House of Representatives on March 31, when the House Committee on Interstate and Foreign Commerce voted against reporting the bill. This means that any future train-limit proposal will have to start a new journey through Congress since the present bill will die when Congress adjourns. It has been estimated by the Association of American Railroads that the bill, if passed, would cost the carriers an additional $100,000,000 in out-of-pocket operating expenses, along with outlays totaling $500,000,000 for the rearrangement of facilities. Speaking in opposition to the bill, Senator Bailey of North Carolina warned railroad employes that they "may keep on making demands on the railroads until they kill the goose that lays the golden egg * * *: we cannot continue to put burdens upon the railroads without destroying their capacity to employ men."

Personal Mention

General

Leonor F. Loree, an engineer by training and experience and widely known as one of the country's most able railroad executives, has resigned as president of the Delaware & Hudson, effective March 31, because of ill health. Mr. Loree, who is nearly 80 years of age, was born in Fulton City, Ill., and was educated in civil engineering at Rutgers university. He entered railroad service in 1877 as an assistant on the engineer corps of the Pennsylvania, and

Leonor F. Loree

later served for two years as a transitman with the engineer corps, U. S. Army, and for several years with the Mexican National Railway in various capacities on surveys. In 1883, he returned to the Pennsylvania as an assistant engineer, being promoted to engineer maintenance of way in 1884, in which capacity he served on various divisions. In 1889, he was transferred to the operating department as division superintendent of the Cleveland & Pittsburgh division and in 1896, at the age of 38, he was appointed general manager of the Pennsylvania, becoming fourth vice-president in 1901. Shortly thereafter Mr. Loree became president of the Baltimore & Ohio, leaving this post four years later to become president of the Chicago, Rock Island & Pacific and chairman of the Executive committee of this company and of the St. Louis-San Francisco. After nine months in these capacities he became chairman of the Executive committee of the Kansas City Southern, which position he held until 1937. He has served as president of the Delaware & Hudson since 1907. At various times he had also served as chairman of the board of the Missouri-Kansas-Texas and as a director of various railroads. Mr. Loree was president of the American Railway Association between 1899 and 1901, and in 1913 he served as chairman, Eastern group, Presidents' Conference Committee on Valuation.

Edward A. Dougherty, assistant chief engineer of the New York Central, with headquarters at New York, has been appointed assistant to the vice-president of the New York Central System, with headquarters at Chicago. Mr. Dougherty entered the service of the New York Central as a chainman in the engineering department on June 15, 1906, and worked during the summer vacations of 1906-1909 while attending the School of Mines, Columbia University, from which he was graduated as a civil engineer in 1910. From 1910 to 1917 he served in the engineering department in various positions from chainman to assistant engineer and during this period he worked on the electrification of the New York Central between Mott Haven, N. Y., and Croton-on-Hudson, N. Y., and also on third and fourth tracking at various points. From 1917 to 1919, Mr. Dougherty served in the valuation department as assistant engineer and from 1919 to 1923 as assistant engineer in the office of the corporate chief engineer and assistant to the president. From 1923 to February 1, 1926, he was connected with the office of assistant vice-president and vice-president of operation. On February 1, 1927, he was appointed designing engineer in the office of the chief engineer of the Lines East of Buffalo, which position he held until May 1, 1935, when he was appointed assistant chief engineer there, the position he held until his recent appointment to the position of assistant to vice-president at Chicago.

Engineering

P. O. Ferris, assistant engineer maintenance of way of the Delaware & Hudson, with headquarters at Albany, N. Y., has been promoted to division engineer of the Susquehanna division, with headquarters at Oneonta, N. Y., to succeed **F. P. Gutelius, Jr.,** who has resigned.

F. J. Jerome, who has been promoted to the newly-created position of engineer maintenance of way of the Michigan Central (part of the New York Central System), with headquarters at Detroit, Mich., as reported in the April issue, was born at Painesville, Ohio, on May 26, 1890. He was graduated from Williams College in 1911 and from Massachusetts Institute of Technology in 1914, entering railway service with the New York Central on July 6, 1914, as a transitman at Elyria, Ohio. In March of the following year he was moved to Toledo, Ohio, and two years later he was appointed assistant engineer at Chicago. He served as trainmaster at that point from August 20, 1923, until November 1, 1927, when he became division engineer at Chicago, holding this position until his recent promotion.

L. B. Elliott, assistant division engineer on the Cleveland, Cincinnati, Chicago & St. Louis (a unit of the New York Central System), with headquarters at Springfield, Ohio, has been promoted to division engineer of the Illinois division, with headquarters at Mattoon, Ill., to succeed **E. H. McGovern,** who has been transferred to Chicago as division engineer on the New York Central, as reported in the April issue. **H. E. Woodburn** has been appointed assistant division engineer of the Peoria & Eastern (also part of the New York Central System), with headquarters at Indianapolis, Ind., where he replaces **E. J. Bayer,** who has been transferred to Springfield on the Big Four to succeed Mr. Elliott.

Mr. Elliott has been identified with the Big Four continuously for about 30 years. He was born in February, 1883, at Washington Court House, Ohio, and is a graduate of Ohio State University. Mr. Elliott first entered railway service with the Big Four in December, 1908, as an assistant engineer at Wabash, Ind., later serving in the same capacity at Indianapolis, Ind. From April to October, 1912, he served as a draftsman in the chief engineer's office at Cincinnati, then returning to the position of assistant engineer, in which capacity he served at both Wabash and Indianapolis. On November 15, 1913, he was made a track supervisor at Harrisburg, Ill., and on September 1, 1914, he became a pilot on valuation survey work at Cincinnati. From March 1, 1917, to September 1, 1919, Mr. Elliott served as engineer maintenance of way successively at Indianapolis and Springfield, then becoming engineer maintenance of way of the Peoria & Eastern. On May 1, 1924, he returned to Springfield in the same capacity, being appointed assistant division engineer at that point on June 1, 1933. He was holding this position at the time of his recent appointment as division engineer at Mattoon.

A. F. Blaess, chief engineer of the Illinois Central, with headquarters at Chicago, has retired, effective May 1, thus bringing to a close 41 years of continuous service with this company. Mr. Blaess, who is a native of Ann Arbor, Mich., was born on January 6, 1871, and received his higher education at the University of Michigan, graduating in civil engineering in 1895. His first railway connection was with the

A. F. Blaess

Detroit & Mackinac, which company he left in 1897 to go with the Illinois Central as a track apprentice. After several months in this capacity he was made a rodman, later serving as a transitman. In 1900, he was made a resident engineer and after a year in this capacity he was promoted to assistant engineer. From 1902 to 1905, Mr. Blaess served as a track supervisor, and in the latter year he was further promoted to roadmaster. After five years in this capacity he was made assistant engineer maintenance of way and in 1913 he was appointed district engineer. In the following year he was promoted to engineer maintenance of way and held this position for 11

years. He has served as chief engineer since 1925. During his period of service as chief engineer Mr. Blaess had supervision over a number of major engineering projects, including the construction of the 169-mile Edgewood cut-off, the building of the Bonne Carre Spillway bridges of the Illinois Central and the Yazoo & Mississippi Valley, the reconstruction of the south approach to the Ohio River bridge at Cairo, Ill., the construction of the company's extensive locomotive repair facilities at Paducah, Ky., and the prosecution of an extensive track elevation project at Jackson, Miss. For many years he has been active in the affairs of the American Railway Engineering Association, serving as a director from 1924 to 1926 and as treasurer from 1930 to date. Altogether he has served on eight different committees of the A.R.E.A. and has been vice-chairman of the Committee on Rail since 1929.

John M. Doorly, engineer of the New York Terminal district of the New York Central, has been appointed assistant chief engineer (Buffalo and East), with headquarters at New York, succeeding **E. A. Dougherty,** whose promotion to assistant to the vice-president is noted elsewhere in these columns. **Alfred D. Wolff, Jr.,** assistant engineer, New York Terminal district, has been appointed designing engineer, with headquarters at New York .

Mr. Doorly entered the service of the New York Central on May 15, 1905, as a draftsman on the West Side Improvements at New York and on November 1, 1906, became an assistant engineer. On January 1, 1914, he was appointed assistant engineer on the West Side Improvements and on January 1, 1927, he was appointed engineer of the New York Terminal district, the position he held until his recent appointment as assistant chief engineer (Buffalo and East).

Mr. Wolff entered the service of the New York Central as a draftsman in the engineering department at New York on June 3, 1910, becoming an assistant engineer on January 1, 1912, and resident engineer at Poughkeepsie, N.Y., on April 16, 1916. On December 16, 1916, Mr. Wolff became assistant district engineer, Hudson River Connecting Railroad, on the Castleton bridge cut-off. From 1918 to 1922, he was assistant district engineer and assistant engineer at Albany and from 1922 to 1926 he served as assistant engineer in charge of valuation work under order No. 3, Buffalo and East, at New York. In 1926, Mr. Wolff became assistant engineer, New York Terminal district on West Side Improvements, which position he held until his recent appointment as designing engineer.

John D. Morris, supervisor of track on the Philadelphia Terminal division of the Pennsylvania, with headquarters at Philadelphia, Pa., who has been promoted to division engineer on the Monongahela division, with headquarters at Pittsburgh, Pa., as reported in the April issue, was born at Sykesville, Md., on December 7, 1905. He was graduated from the University of Maryland in 1926, and on June 14 of the same year he entered the service of the Pennsylvania as a rodman on the Pittsburgh division. In February, 1927, he was transferred to the Eastern region as an assistant on the engineering corps, and in April of the same year he was appointed assistant supervisor of track on the Middle division, with headquarters at Hollidaysburg, Pa. About one month later he was transferred to the main line of the New York division, with headquarters at Jersey City, N.J., and subsequently served as assistant supervisor at Downingtown, Pa., and Tyrone. On April 10, 1929, Mr. Morris was promoted to supervisor of track, with headquarters at Harrington, Del., and in September, 1931, he was transferred to Lock Haven, Pa., where he remained until December, 1932, when he was appointed acting supervisor of track at Tyrone. In July, 1933, he was appointed supervisor of track on the Middle division, with headquarters at Newport, Pa., and in November, 1935, he was transferred to the office of the vice-president and comptroller for special training in accounting. In January, 1937, Mr. Morris was appointed supervisor of track on the Philadelphia Terminal division, with headquarters at Pittsburgh, the position he was holding at the time of his recent promotion to division engineer.

Track

J. A. Maughan has been appointed supervisor of track on the Lehigh Valley, with headquarters at Easton, Pa., to succeed **E. F. Dinan,** who has been transferred.

A. Stamos, roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Des Moines, Iowa, was transferred to El Dorado, Ark., effective April 11, succeeding **J. E. Crawford,** who in turn has been transferred to Des Moines, replacing Mr. Stamos.

Fred White has been appointed roadmaster on the Terre Haute division of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Terre Haute, Ind., succeeding **R. R. Lowe,** who has been assigned to other duties. Mr. White was formerly located at Panora, Iowa.

S. A. Merwin, roadmaster on the Chicago, Burlington & Quincy, with headquarters at Orleans, Neb., has been transferred to Wymore, Neb., to succeed **F. M. Hoenshell,** deceased, and **S. J. Owens, Jr.,** assistant roadmaster at Omaha, Neb., has been promoted to roadmaster at Orleans, succeeding Mr. Merwin.

J. E. Dixon, assistant supervisor of track on the Eastern Region rail train of the Pennsylvania, has been transferred to the Maryland division, with headquarters at Perryville, Md. **J. C. Skinner,** assistant supervisor of track at Downingtown, Pa., has been transferred to the Middle division, with headquarters at Lewistown, Pa. **J. L. Tedesco,** assistant supervisor of track at Williamsport, Pa., has been transferred to Lock Haven, Pa., and **G. C. Vaughn,** acting supervisor of track on the Eastern Pennsylvania division, has been appointed assistant supervisor of track on the Philadelphia Terminal division, with headquarters at Philadelphia, Pa.

Virgil I. Kessinger, who has been appointed roadmaster on the Southern Kansas division of the Atchison, Topeka & Santa Fe, with headquarters at Independence, Kan., as reported in the April issue, has been identified with this company for 17 years. He was born on September 25, 1901, at Beggs, Okla., and entered the service of the Santa Fe on March 8, 1921, as a student track foreman. On November 16 of the same year he was promoted to section foreman and continued in this capacity until his recent appointment. During a number of working seasons Mr. Kessinger served as an extra gang foreman and for three years he was yard foreman at Coffeyville, Kan. At the time of his recent promotion he was located as section foreman at Collinsville, Okla.

John Gall, acting supervisor of track on the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Anderson, Ind., has been appointed supervisor of track at Harrisburg, Ill., to succeed **A. Handley,** who has been transferred to Lynn, Ind., to relieve **J. P. Davis,** who has succeeded Mr. Gall at Anderson. Mr. Gall had served as acting supervisor of track at Anderson since March 8, when he was appointed to that position to succeed **William Van Gorder,** who died on March 7.

Mr. Gall was born on May 19, 1894, at Silver Lake, Ind., and entered the service of the Big Four as a section laborer in 1914, serving in that capacity until early in 1918, when he joined the army. After the close of the war he returned to the Big Four and served as a section foreman successively at North Manchester, Ind., Warsaw and Marion. He was located at the latter point at the time of his appointment as acting supervisor of track on March 8.

Frank J. Kovaleski, who has been appointed roadmaster on the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Madison, S. D., as noted in the April issue, was born on December 8, 1890, at Owatonna, Minn. Mr. Kovaleski began his railway career as a section laborer with the Milwaukee at Medford, Minn., on March 28, 1907, and was promoted to section foreman on March 15, 1910. In March, 1925, after serving as section foreman and yard foreman at various points, he was promoted to roadmaster on the Iowa division. He was transferred to the Twin City terminals in 1930, where he remained until January 1, 1931, when, as a result of force reductions, he was appointed yard foreman at Faribault, Minn., where he was located at the time of his recent promotion. Mr. Kovaleski has also served at various times as an extra gang foreman.

Leo W. Green, assistant supervisor of track on the Middle division of the Pennsylvania, with headquarters at Lewistown, Pa., who has been promoted to supervisor of track, with headquarters at Buffalo, N. Y., as reported in the April issue, was born in Swayzee, Ind., on January 14, 1909. Mr. Green was graduated from Purdue University in 1930 with a degree in civil engineering and entered the service of the Pennsylvania in June, 1930, as an assistant on the engineering corps at Lewistown, where he remained until February, 1931, when he was promoted to assistant supervisor of track on the Williamsport division, with headquarters at

Here's the rail brace

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Here is a rail brace that cuts maintenance on high-speed turnouts and crossovers. It gives plenty of support to the rail. It cushions the shock of fast-moving wheels. It simplifies maintenance, for it can be adjusted, at any time, with only a hammer or track maul. It meets specifications as to fit and adjustment of A.R.E.A. Plan 240.

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When the Bethlehem Spring Rail Brace is installed, or at any later time, it can be adjusted by this simple operation: raise the pawl or finger which locks the wedge in place; drive up the wedge which controls pressure between the rail and the brace; drop the pawl into the next slot. Range of adjustment is one-half inch, in steps of 1/16 inch.

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Lock Haven, Pa. A few months later he returned to the position of assistant on the engineering corps at Lock Haven, where he remained until April, 1934, when he was reappointed assistant supervisor of track, holding this position successively at Harrisburg, Pa., Wilmington, Del., York, Pa., Lewistown and Downingtown. In May, 1937, Mr. Green returned to Lewistown as assistant supervisor, where he was located at the time of his recent appointment.

Miles L. Bradbury, who has been promoted to roadmaster of Sub-division No. 1 of the Southern Illinois division of the Chicago & North Western, as reported in the April issue, was born in Sheboygan Falls, Wis., on March 19, 1898. Mr. Bradbury took a business course and later studied engineering at the University of Missouri and also attended evening sessions at Lewis Institute, Chicago. He first entered railway service with the Chicago & North Western on February 8, 1916, as a rodman, with headquarters at Fond du Lac, Wis.

Later he served successively as chief clerk to the division engineer at Escanaba., Mich, as an inspector on concrete construction at Fond du Lac, and as chief clerk to the division engineer at Antigo, Wis. During the war he saw military service with the 108th Engineers of the Illinois National Guard, returning to railroad service with the North Western in July, 1919, as chief clerk to the division engineer at Escanaba. Subsequently he served in the same capacity in the office of the assistant engineer of maintenance at Omaha, Neb., as an instrumentman at Chadron, Neb., as chief clerk to the division engineer at Chicago, as an instrumentman at Norfolk, Neb., and as assistant roadmaster at Sterling, Ill., being located at the latter point at the time of his recent promotion to roadmaster at South Pekin, Ill.

Bridge and Building

W. M. Seals has been appointed supervisor of scales on the Mobile & Ohio, with headquarters at Jackson, Tenn., succeeding **J. C. Lockert,** who has retired from service.

W. L. Stokes, a bridge foreman on the Mobile & Ohio, has been promoted to supervisor of bridges and buildings of the Mobile and Meridian districts, with headquarters at Meridian, Miss., to succeed **J. A. Youngblood,** deceased.

George W. Higgins, who has been in charge of water service for the Pere Marquette at Traverse City, Mich., on April 1 was appointed supervisor of bridges and buildings on the Chicago-Petoskey division, with headquarters at Grand Rapids, Mich., to succeed **John Robinson,** who has retired. Mr. Higgins was born on March 22, 1876, at Holland, Mich., and entered the service of the Pere Marquette on September 11, 1899, as a carpenter. In May, 1902, he was appointed foreman of bridges and buildings and served in that capacity until June, 1922, when he was promoted to supervisor of bridges and buildings, which position he held until 1932, when he was placed in charge of water service at Traverse City. He remained in this capacity until his recent reappointment to the position of supervisor of bridges and buildings at Grand Rapids.

Special

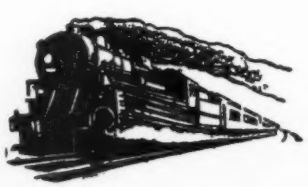
S. C. Tanner, superintendent of the maintenance of way shop of the Baltimore & Ohio at Martinsburg, W. Va., has retired effective April 1, 1938. Mr. Tanner was born at Custer Park, Ill., on February 20, 1865, and entered railroad service as a laborer on the Wabash in 1880. After working on a number of different railroads he was appointed bridge and building foreman on the B. & O. at Parkersburg, W. Va., in September, 1895. On May 1, 1903, Mr. Tanner was promoted to master carpenter with headquarters at Parkersburg, and served in this capacity at Cumberland, Md., and on the Baltimore division until January 16, 1921, when he was promoted to superintendent of the maintenance of way shops at Martinsburg, the position he held when he retired. Mr. Tanner has long been active in the American Railway Bridge and Building Association and in 1918 was president of that organization.

Obituary

F. M. Hoenshell, roadmaster on the Chicago, Burlington & Quincy, with headquarters at Wymore, Neb., died suddenly on April 7.

T. M. Moriarty, who retired in June, 1937, as roadmaster of the Pacific Coast, with headquarters at Seattle, Wash., died at that point, on April 10 at the age of 74 years.

J. B. Skeen, valuation engineer of the Coast lines of the Atchison, Topeka & Santa Fe, with headquarters at Los Angeles, Cal., died on March 29 following an operation. Mr. Skeen was born at Princeton, Ind., on July 6, 1874, and first entered railroad service with the Santa Fe as a carpenter in 1895, serving in bridge construction work in Kansas and Colorado until 1899, when he resigned. In 1903, he returned to the service of the Santa Fe, serving as clerk and bridge foreman on the San Francisco & Northwestern at San Francisco. From 1906 until 1912 he served as bridge inspector, building inspector and chief clerk to the chief engineer at Amarillo, Tex. In 1912, he was transferred to Los Angeles as assistant engineer and four years later he was promoted to valuation engineer of the Coast lines, which position he was holding at the time of his death.



Supply Trade News

General

The Duff-Norton Manufacturing Company, Pittsburgh, Pa., has moved its New York sales offices from 250 Park avenue to 3411 Empire State building.

The Buda Company, Harvey, Ill., has appointed the **Wm. H. Ziegler Co., Inc.,** Minneapolis, Minn., as its sales agent in that territory for the railway division.

Personal

Henry W. Collins, sales manager in the New York division for the **Celotex Corporation,** has been elected vice-president. **J. Z. Hollmann,** assistant general sales manager of this company, has been appointed general sales manager.

William P. Andrews, assistant manager of sales in the Chicago district of the **Carnegie-Illinois Steel Corporation,** has been appointed manager of sales of the Cincinnati district, succeeding **Lawrence K. Slaback,** deceased. **T. Lane Watson,** who has been in charge of the bar strip and semi-finished materials division at Chicago, has been promoted to assistant manager of sales of the Chicago district to succeed Mr. Andrews.

Herbert H. Moffitt, Hill building, Washington, D. C., has been appointed southern district manager for **The Rails Company,** New Haven, Conn.

Curtis S. Garner, general manager of erection of the **American Bridge Company,** (subsidiary of the **United States Steel Corporation**) has been elected a director and vice-president, with his headquarters, as formerly, at Pittsburgh, Pa. In addition Mr. Garner will continue in full charge of erecting operations.

The United States Steel Corporation, at a meeting of its board on April 5, elected **Edward R. Stettinius, Jr.** as chairman of the board, succeeding **Myron C. Taylor,** and Mr. Stettinius retired from the chairmanship of the finance committee. **Edward M. Voorhees** retired as vice-chairman of the finance committee and was elected chairman of that committee. **Benjamin F. Fairless** was re-elected president of the United States Steel Corporation of New Jersey.

American Railway Excavators, Inc., has been formed for the purpose of installing drain and culvert pipe in embankments by means of a new process. Officers of the company are: **W. E. Hicks,** president; **C. H. Hunsaker,** vice-president in charge of sales, both having headquarters in the general office of the company, which is located in the Missouri Pacific building, St. Louis, Mo.; and **W. P. Tobin,** vice-president in charge of operations and treasurer, and **M. O'Connor,** secretary, who are located in a branch office at 220 West Thirty-ninth street, Kansas City, Mo. **E. C. Alexander** is chief engineer, with headquarters at Chicago.

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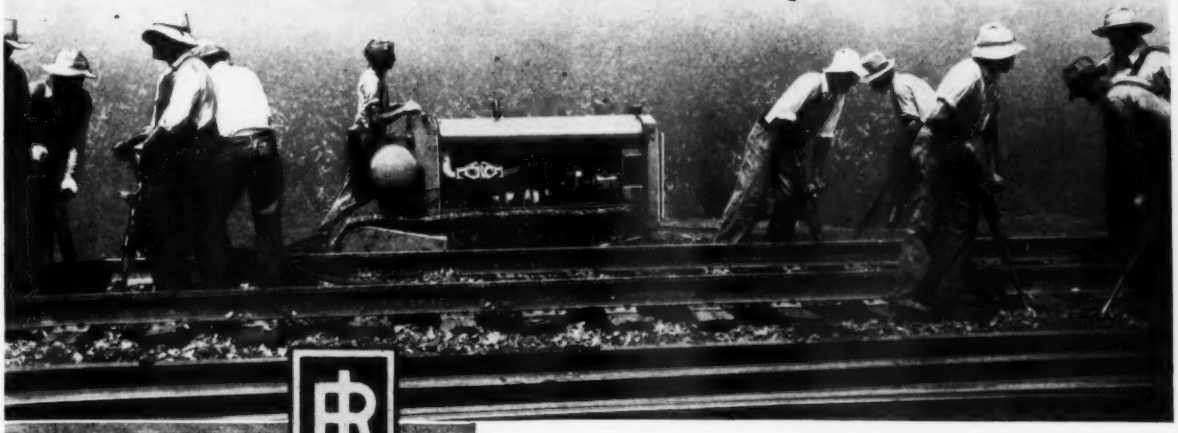

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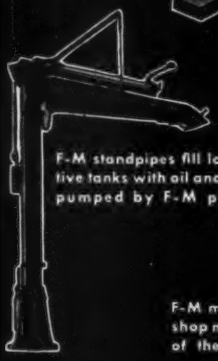

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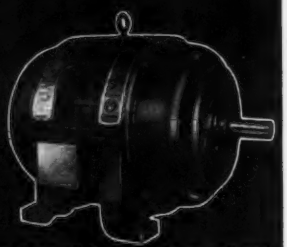
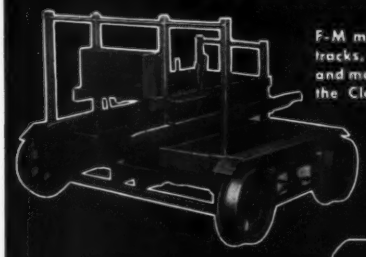
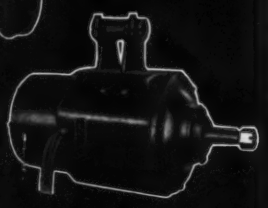


F-M motors drive air conditioning systems, railroad shop machine tools, water station pumps, and some of the largest railroad terminal grain elevators.



F-M motor cars patrol tracks, transport men and materials on all of the Class I railroads.



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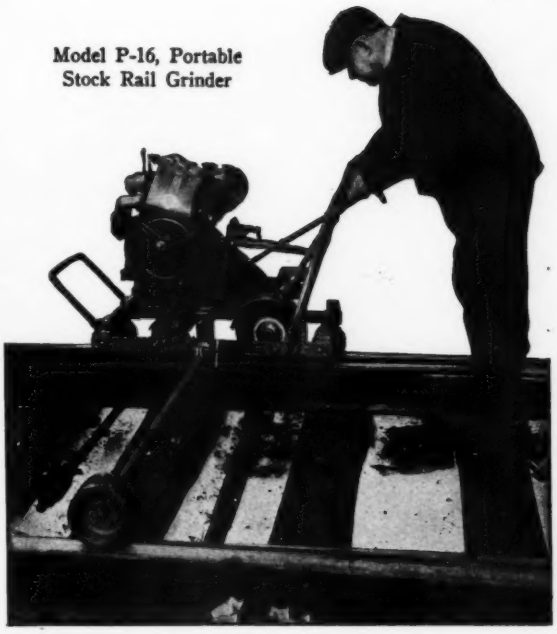

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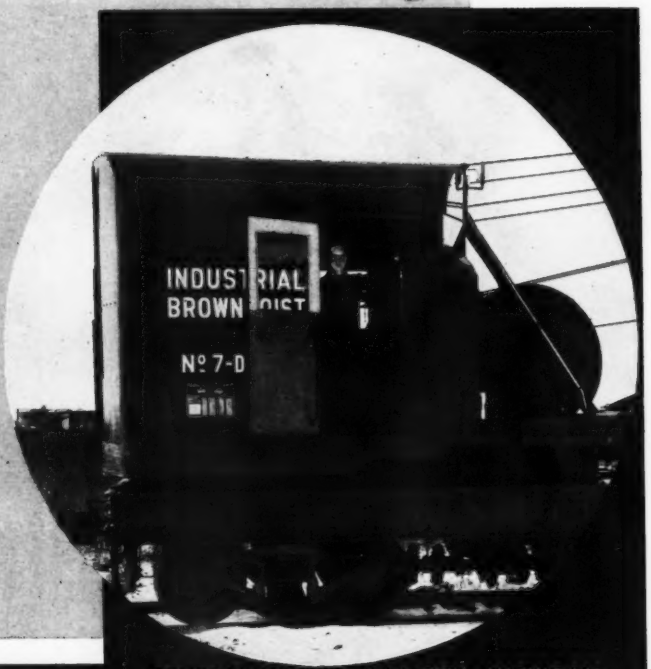

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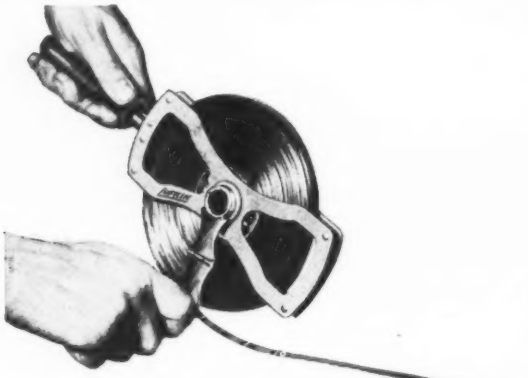

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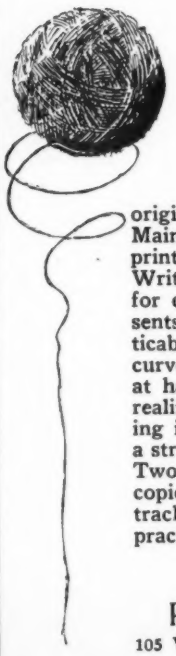

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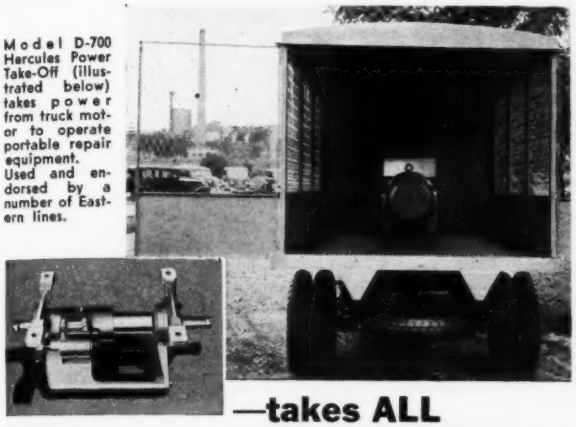

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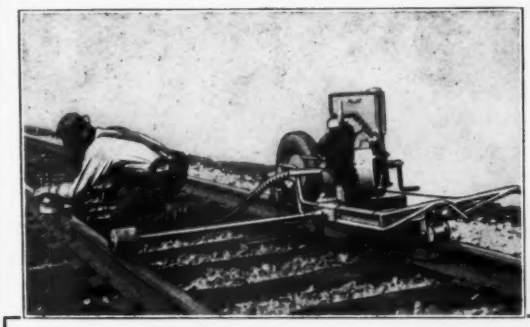

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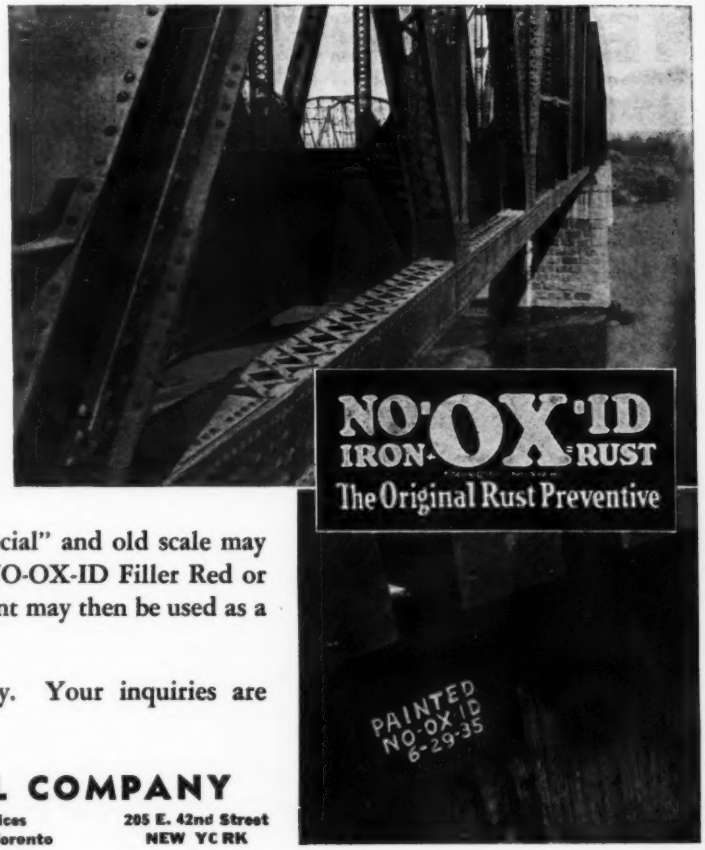

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Your Name.....

Railroad.....

Address.....

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10 Car Stock
11 Structural Timber
12 Fences
13 Piers, Wharves
14 Cooling Towers
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16 Flume
17 Trench Lining and Covers

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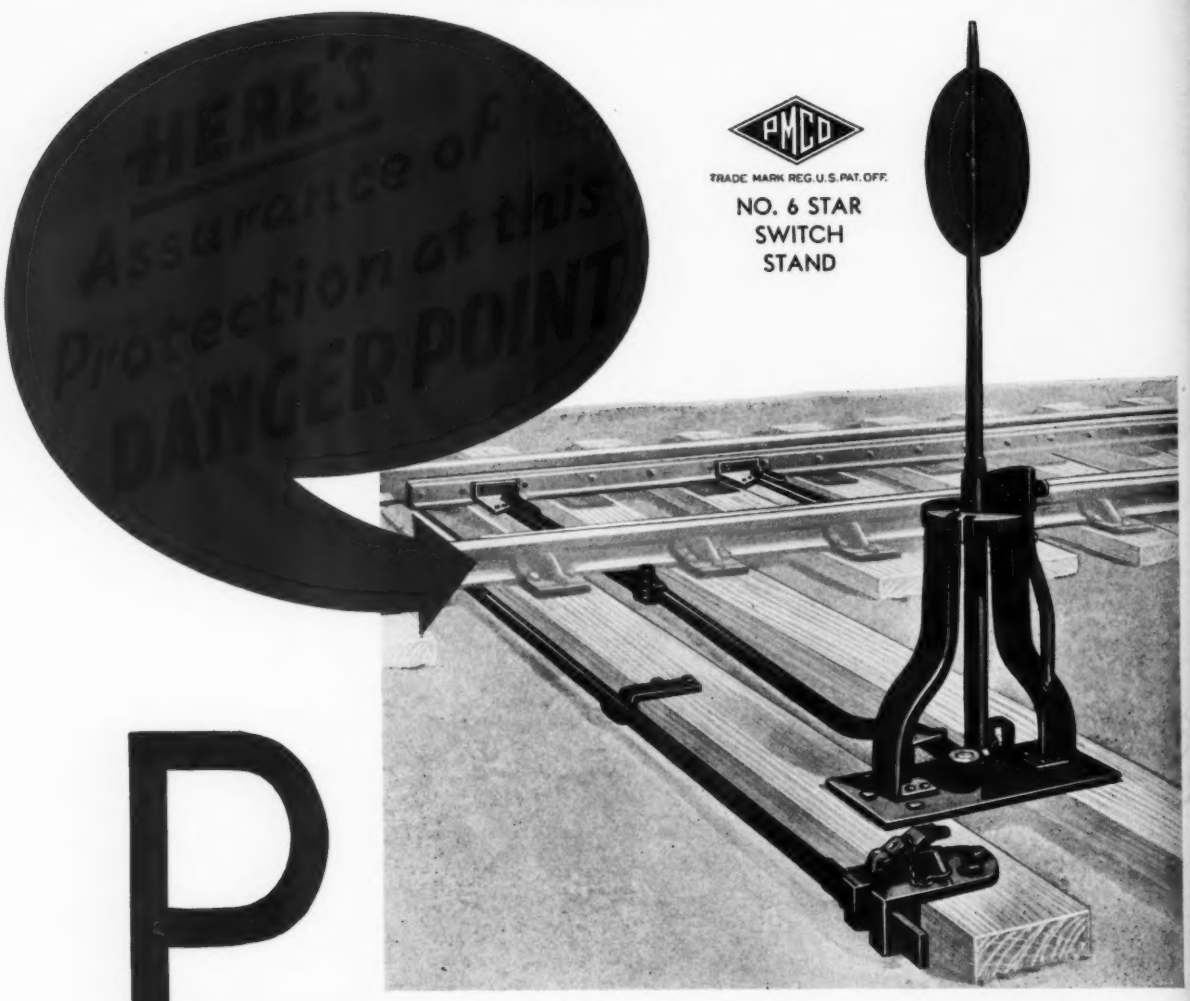

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PAT. NO. 1,695,900

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Many hundreds of Pettibone Mulliken Switch Point Locks are in use today on major railroad systems.

Switches — Crossings — Frogs — Guard Rails — Switch Stands — Mechanical Switchman — Asselin Permanent Base Crossings

PETTIBONE MULLIKEN CORPORATION

Chicago, Illinois